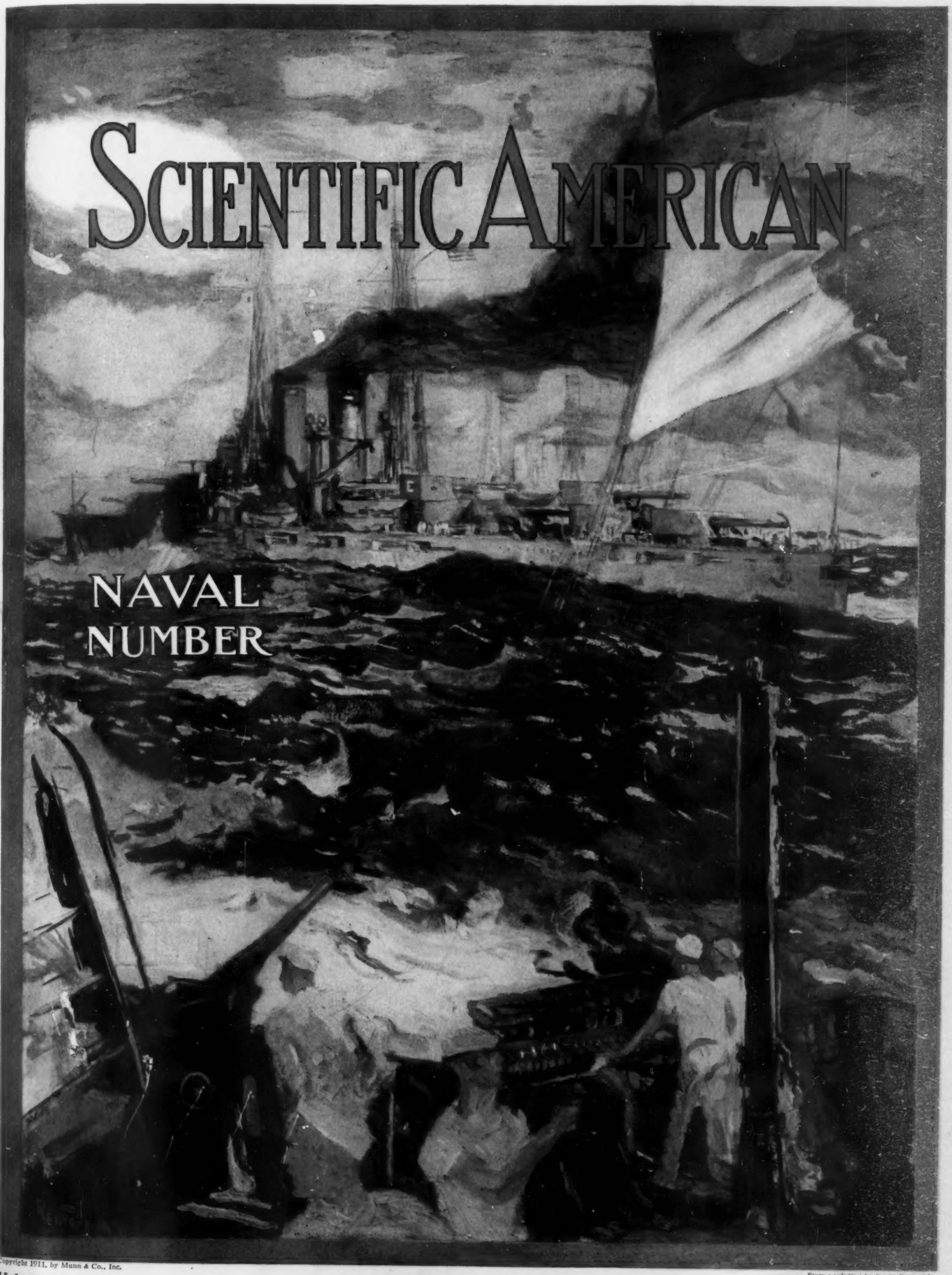
PRESIDENT TAFT

To the Editor of the Scientific American:

"Until peaceful means of settling all International Controversies are assured to the World, prudence and patriotism demand that the United States maintain a navy commensurate with its wealth and dignity."

October 27, 1911



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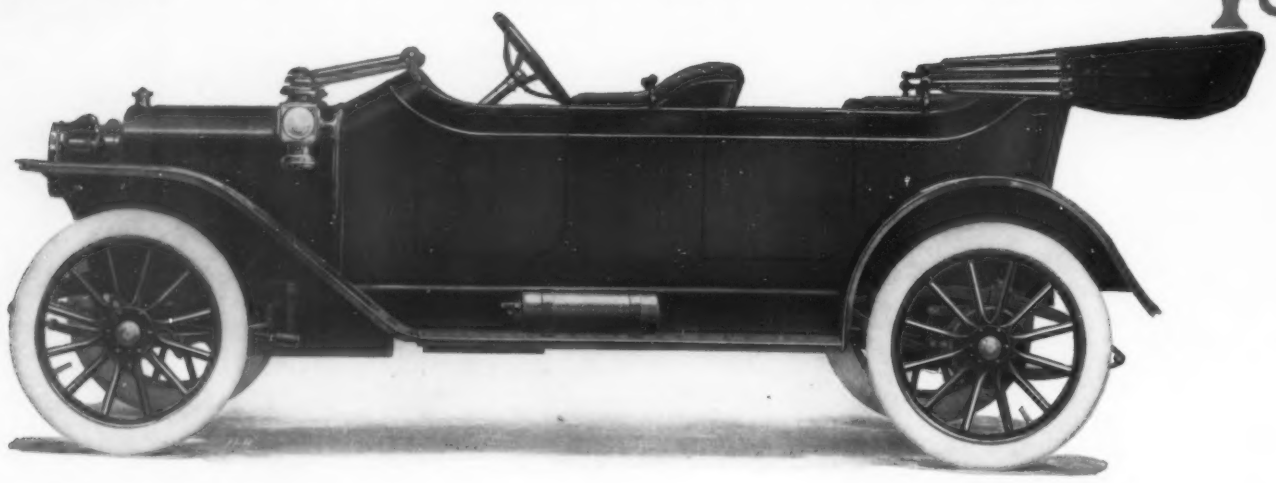
From a painting by Henry Reuterdahl.

Vol. CV. No. 24
December 9, 1911

Munn & Co., Inc., Publishers
New York, N. Y.

Price
15 Cents

R-C-H "Twenty-Five" 5-Passenger Touring Car



$850 F. O. B. Detroit

Fully equipped with top, side-curtains, windshield, 2 gas lamps, 3 oil lamps, generator, horn, tools and tire repair kit--- long stroke motor---three speeds---enclosed valves---Bosch magneto.

An Astonishing Price---An Astonishing Car

Buy the car value that beats it---if you can find one

The first thing that will strike most people in reading of the R-C-H will be the price. And this is natural. For a completely equipped car of this type has never been offered at anything approaching this figure.

Judged on price alone—the R-C-H—touring car, roadster or coupe—stands in a class of its own. But it's not on price—it's on **what you get for the price,** that we want you to judge the car.

What Makes the R-C-H Possible

Briefly, the most thorough systematization of factory and cost problems that the automobile industry has ever seen. Little leaks, small wastes, lack of co-operation between different departments—these have been features of motor-car manufacture. Such leakage, wastage and lack of system lost only a few dollars here and a few dollars there, but they made in the aggregate a wonderful difference in the price you paid for your car.

No man, perhaps, was better fitted to appreciate these things than R. C. Hupp. He has seen service in every department of the business, culminating as head of the purchasing and repair departments of one of the largest factories in the world.

He made up his mind that with manufacturing, factory and purchasing problems properly simplified, a high-grade car could be produced at a price that would be revolutionary in the industry. And the R-C-H, turned out in the model Hupp plants, has proved his contention.

Go through the Hupp plants from end to end and you'll see all the mechanism of a vast business working with absolute precision for perfection, but you won't find a dollar of wasted money, or an hour of wasted effort.

How the R-C-H is Made

We could not build better for a car at any price.

Chrome nickel steel is used throughout all shafts and gears in the transmission and rear axle, and high carbon manganese steel in all parts requiring special stiffness. 123 drop forgings are used—a larger number than in any other car in the world—irrespective of price.

The R-C-H crank-shaft is as large as that in many 40-horse power cars. The radiator has one-third more cooling space than in other cars of this type.

The long-stroke motor (3¼-5) develops exceptional power and speed. The springs—full elliptic rear and semi-elliptic front—insure easy riding.

You owe it to yourself to investigate the R-C-H thoroughly, and if we can get you to do that we're satisfied. For if the R-C-H will not sell itself to you on your own investigation and judgment we don't want you to buy it. Compare it, detail for detail, with any car you have in mind at $1500—or even higher. That is all we ask.

You can see the car at any of our branches or at local dealers everywhere. Descriptive folder will be sent on request.

Canadian Prices

R-C-H 2-passenger roadster, $850; equipped for 4 passengers, $925. R-C-H 5-passenger touring car, $1050. R-C-H Gasoline coupe, $1300. All prices F. O. B. Windsor, Ont., duty paid.

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A very little choice territory still remains open on this 1912 sensation. It's going fast.

If you're the right man we have a proposition of interest for you.

Specifications: Motor—4-cylinders, east en bloc.—3¼ inch bore, 5 inch stroke. Two bearing crank shaft. Timing gears and valves enclosed. Three point suspension. DRIVE—*left hand.* Irreversible worm gear, 16 inch wheel. CONTROL—*Center lever operated through H plate,* integral with universal joint housing just below. Springs—Front, semi-elliptic and mounted on swivel seats. FRAME—Pressed steel channel. AXLES—Front, I Beam, drop-forged; rear, semi-floating type. BODY—English type, extra wide front seats. WHEEL BASE—110 inches. TIRES—31x3½ inches all around. Full equipment quoted above.

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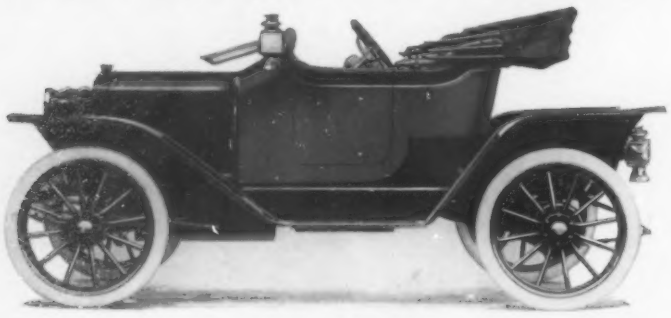


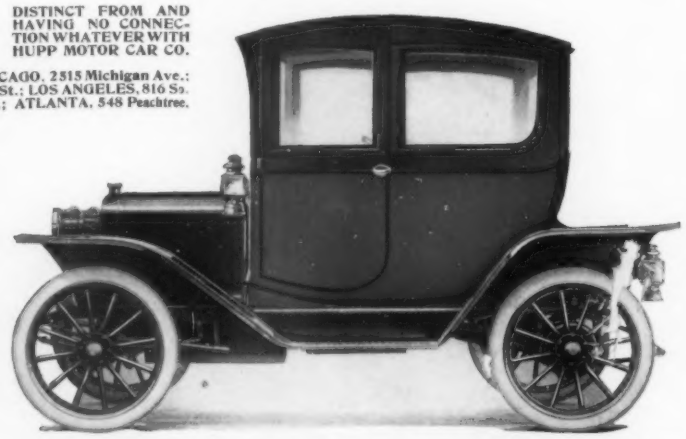
R-C-H "Twenty-Five" English-body Roadster

$700 F. O. B. Detroit

Fully equipped with top, windshield, gas lamps and generator—long stroke motor—three speeds—enclosed valves—Bosch magneto.

The ideal car for five large classes of the public: (A)—The business or professional man. (B)—The farmer. (C)—The salesman. (D)—The pleasure car owner with small or no family. (E)—The large-car owner who needs a smaller car, economical in up-keep for day-to-day motoring uses.

Specifications: Body—English type, extra wide seats. Wheel base—86 inches. Tires—30x3 inches all around. Full equipment includes top, windshield, gas lamps and generator. Equipped to carry 4 passengers—$750. Other specifications same as touring car.



"Twenty-Five" Colonial Coupe R-C-H

All the comfort, ease and elegance that you can want in a closed car.

$1050 F. O. B. Detroit

Specifications: Enclosed body, concealed hinges, drop seat for third person, 100 ampere hour lighting battery. Full equipment includes 2 electric head lamps, combination electric and oil side and tail lamps, horn, tools and tire repair kit. Other specifications same as roadster.

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Has Every Kind of Work For Ambitious Men

SUCCESSFUL applicants for Navy positions find work, not only as seamen, but as machinists, firemen, stenographers, bookkeepers, musicians, carpenters, blacksmiths, shipfitters, electricians, boilermakers, cooks, stewards, waiters, and others.

This is why so many young men who have taken for granted that there was no kind of work in the Navy that they would like, have found, on investigation, more agreeable work and more variety of positions than in civil life.

The United States Navy offers a life that is healthy; work that is pleasant; excellent opportunity for promotion; the incentive to save money; and the finest of chances to learn by study and travel. And besides these things, companionship of ambitious men of good character.

The Navy Department never urges men to enlist, only to investigate Navy opportunities. It is worth the while of any man, 17 to 35 years of age, to look into the subject of taking four years' training in the Navy, or of making the Navy a life's work.

Call at the nearest Navy Recruiting Station (we'll send address at your request) and ask all the questions you wish. Or send for interesting free book, "The Making of a Man o'Watsman" Address

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Box 39, Navy Dept. Washington, D. C.

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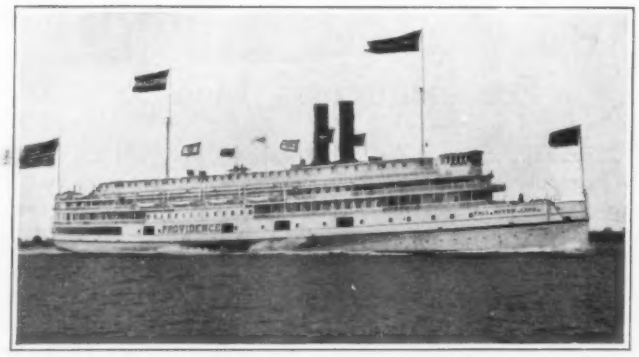
Ship and Engine Builders

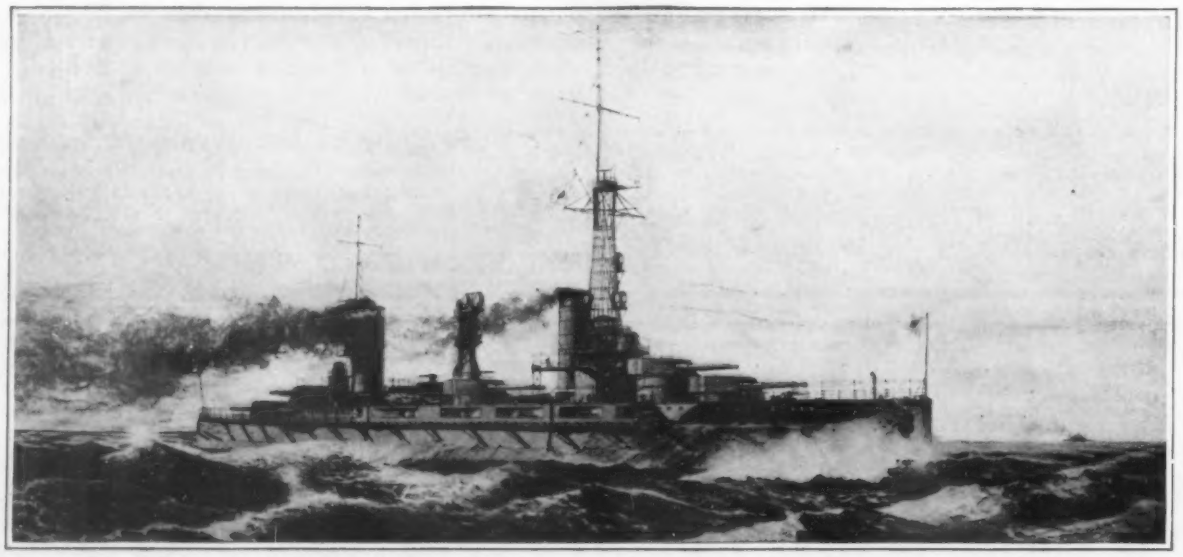
Full load displacement, 17,650 tons. **Speed,** 18.33 knots. **Coal supply,** 2,428 tons. **Armor:** Belt 9-inch; turrets 12-inch. **Guns:** Four 12-inch; eight 8-inch; twelve 7-inch.

U. S. S. "Vermont"



Length, 396 feet 6 inches. **Beam,** 88 feet. **Tons gross,** 4,365. **Speed,** 17½ knots. **Passenger accommodation.**

S. S. "Providence"

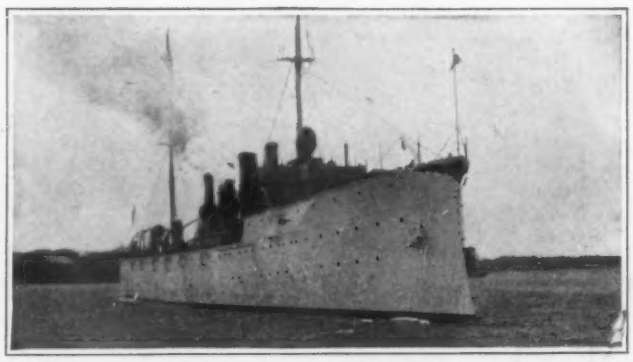


Length over all, 585 feet. **Beam,** 98 feet. **Full load displacement,** 30,200 tons. **Speed,** normal draft, 22½ knots. **Maximum coal supply,** 4,000 tons. **Radius,** at 11 knots speed, 10,000 knots. **Armor:** Belt 12-inch; turrets 12-inch. **Guns:** Twelve 50-caliber 12 inch; twelve 6-inch; sixteen 4-inch. **Torpedo tubes,** two 21-inch.

Argentine Battleship "Rivadavia" — *Largest warship in the world.*

Length, 400 feet. **Beam,** 54 feet 6 inches. **Speed,** 12 knots. **Capacity of carrying,** 7,200 tons of coal.

Collier "Newton"



Length, 420 feet. **Beam,** 46 feet 8 inches. **Speed,** 25 knots. **Displacement,** 3,750 tons. **Coal supply,** 1,372 tons. **Radius of action** at 10 knots speed=6,000 knots.

U. S. S. "Salem"

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Yarrow Boilers

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SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 24.] NEW YORK, DECEMBER 9, 1911 [15 CENTS $3.00 A YEAR

GEORGE v. L. MEYER, SECRETARY OF THE NAVY.

SCIENTIFIC AMERICAN

Founded 1845

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Importance of the Command of the Sea

THE existing contest between Italy and Turkey, confined as it is to the sea and to the possession of Tripoli, has a double interest. It illustrates on the one hand the gradual, yet perpetual, process by which a higher civilization impinges upon a lower; that is, upon one that is lower in virile efficiency, however in some instances it may have been higher in acquired material comfort, or even in literary and artistic achievement. This tendency can neither be regulated by law, nor brought to the bar of law, without injury to the progress of the world toward better universal conditions, to which end it is essential that the efficient supplant the inefficient. On the other hand, this collision illustrates the importance of the command of the sea. This also, it should be noted, has beeen incidental and determinative in the progress of the world. Through having this command, Italy thus far has been able to localize the land fighting in Tripoli, and probably can continue to do so; to the great relief of her own resources, and that of a watching and anxious Europe.

It is to this second consideration that I am here limited by my subject—"The Importance of the Command of the Sea"—with a somewhat special reference to that importance as touching the United States. The United States in her turn, after having achieved national efficiency, by the quenching of internal discord in a bitter and bloody contest, has found herself compelled inevitably into the same path of seeming aggression upon less efficient social and political communities; to bear her part of "the white man's burden," as it has been styled. For in essence this process is not one of aggrandizement, but of responsibility; responsibility not to law, which always lags behind conditions, but to moral obligation entailed by the particular circumstances of the moment of action.

This moral side of the question is not irrelevant to the military one of the importance of commanding the sea; for granting the end—the moral obligation—the means, if not themselves immoral, follow as a matter of course. Of such means, command of the sea is one. Napoleon said that *morale* dominates war; and it is correspondingly true that a sense of right powerfully reinforces the stability of national attitude and the steadfastness of national purpose. If we have been right, morally, step by step, in the forward march of the past few years, we are morally bound to sustain the position attained, by measures which will provide the necessary means. Of these an adequate navy is among the first; probably, in our case, the chief of all.

Here, as always, it is necessary to recur to experience—to the past—in order to comprehend the present and to project the future. Why do English innate political conceptions of popular representative government, of the balance of law and liberty, prevail in North America from the Arctic Circle to the Gulf of Mexico, from the Atlantic to the Pacific? Because the command of the sea at the decisive era belonged to Great Britain. In India and Egypt, administrative efficiency has taken the place of a welter of tyranny, feudal struggle, and bloodshed, achieving thereby the comparative welfare of the once harried populations. What underlies this administrative efficiency? The British navy, assuring in the first instance British control instead of French and thereafter communication with the home country, whence the local power without which administration everywhere is futile. What, at the moment the Monroe Doctrine was proclaimed, insured beyond peradventure the immunity from foreign oppression of the Spanish-American colonies in their struggle for independence? The command of the sea by Great Britain, backed by the feeble navy but imposing strategic situation of the United States, with her swarm of potential commerce-destroyers, which a decade before had harassed the trade of even the mistress of the seas.

Less conspicuously, but no less truly, to what do Algiers and Tunis, and to what eventually will Morocco, owe redemption from conditions barely, if at all, above the barbarous? To the command of the sea by the nation which already has restored the former two, to be fruitful members of the world community. That South Africa is now a united commonwealth, instead of two opposing communities, such as the North and South of our own country might have been, is due to the same cause; a local preponderance of force insured by sea power. It may safely be claimed that to the navy of the United States chiefly is owing the present Union, instead of the existence of two rival nations vying, or trying to vie, with each other in military preparations, like the nations of Europe. The four years' struggle of the Confederate States might not have ended in exhaustion, had it not been for the blockade, which shut in their cotton and shut out their supplies.

Contrast this impressive exhibit, where the command of the sea has been operative, with the history and achievement of those great States which have not possessed it. Contrast Bosnia and Herzegovina for Austria, Alsace and Lorraine for Germany, with the expansion of France, Great Britain, Holland, and with that which Spain once possessed; now lost through an inefficiency, one of the first symptoms of which was the decay of her navy. The magnificent efficiency of the present German Empire strives now, against almost hopeless disadvantage, for the opportunity to exercise that efficiency outside its European limits. Opportunity was lost through the absence of naval force, in the past centuries, when the maritime countries were occupying, and, in accordance with their respective political aptitudes, were determining the future of immense tracts of the world. Much time must elapse before we shall know the inside history of the still unarranged dispute with France about Morocco; but there is reason to believe that the consciousness of the British navy at the back of France has been one of the large factors in the negotiations. At least it is apparent that bitterness against Great Britain has been even more marked than against France.

The lesson for the United States is plain. In the strategic position before mentioned, in remoteness from Europe, in the rivalries of European nations, we still have a local and international advantage for preponderance in American waters; but it is not so great as to confer certainty without reasonable provision for insuring command of the sea. In the Pacific, which is equally our coast line, and to which the future mostly looks, we have no similar advantage. Much as I dislike and reject the phrase "supremacy in the Pacific," it is true that we there have duties which in case of disputes will require the presence of naval force adequate to command. Duty to the mutual support of our two chief coasts dictates full control of the Panama Canal, which from the military standpoint is the key to any broadly-planned system of preparation for national defence.

But obligation is no less on account of the Philippine Islands. Having assumed control of these under imperative circumstances, we are bound in honor to support an undertaking, our fitness for which is attested by results. To them we are responsible for the maintenance of conditions under which material prosperity can advance, and their dissimilar and discordant inhabitants reach a homogeneous civilization and political development which will enable them to govern themselves. To Cuba, though independent, we owe by specific guarantees the maintenance of a like internal security. These national and international functions can be discharged, certainly, only by command of the sea. The Pacific, the Atlantic, and the Caribbean, with the great controlling stations, Porto Rico, Guantanamo, the Canal Zone, and Hawaii, depend upon this command, the exponent of which is the navy, and in which ships and stations are interdependent factors. To place the conclusion concretely and succinctly, the question of command of the sea is one of annual increase of the navy. This question is not "naval," in the restricted sense of the word. It is one of national policy, national security, and national obligation.

A. T. Mahan
Rear-Admiral, U. S. N.

For an Adequate Navy

IN common with all who believe in the ultimate triumph of the best in human nature, we look forward confidently to that enlightened era, in which the exercise of mutual consideration and simple common sense shall have rendered possible the abolition, in part if not in whole, of the world's vast armaments, and the substitution therefor of an international court of arbitration.

For those of us who have learned to look upon questions of international moment from the broadest possible standpoint, however, it is impossible to overlook the fact that the question of arbitration and partial or complete disarmament is intimately, nay essentially, bound up with our relation to that populous Oriental world—Mohammedan, Buddhistic, and Confucian—whose teeming millions are only now being quickened to a realization of the dignified position which, by every right of ancient civilization and their unquestioned mental equipment and physical resources, they seem entitled to fill in the future history of the world.

The awakening of the Orient to a sense of its latent powers—ushered in, as it was, by the stupendous drama of the Russian-Japanese war, and echoed in the present unrest in India and China, and the existing struggle between Christian and Mohammedan armies—may well give us pause and confirm in us the conviction, voiced by our President, the most distinguished advocate of international arbitration, that "until peaceful means of settling all international controversies are assured to the world, prudence and patriotism demand that the United States maintain a navy commensurate with its wealth and dignity."

The SCIENTIFIC AMERICAN, then, stands for an adequate navy, not for aggression, but as a reasonable insurance upon the national wealth of the United States, which, at the last official estimate, in 1904, had reached the vast total of over one hundred and seven billions of dollars. In the absence of an army adequate for our defense, the protection of our lives and property becomes the duty of the navy; and last year we placed upon the population and wealth of the United States a naval insurance of one hundred and fifty-six million dollars—a very moderate rate of one and one-half per cent. In view of the fact that because of our geographical location we are free from the burden of such enormous armies as are maintained by conterminous European nations, "prudence and patriotism" demand that we carry additional naval insurance, by adding to our line of defense, annually, the four capital ships which are deemed necessary by the Naval Board at Washington.

The SCIENTIFIC AMERICAN stands for an adequate navy, furthermore, because we believe there is no national institution in which the best traditions and finest characteristics of the American people are more carefully fostered and conserved. Nor can we recall any institution, public or private, professional or commercial, in which the national ideals are more lofty, or the measure of their attainment so great. Here, at least, patriotism is divorced from material profit, and here the Flag is scrupulously honored as the sublime emblem of all that is noblest in the past history and future aims of the American people.

The SCIENTIFIC AMERICAN stands for an adequate navy because, as stated by one of the writers in this issue, the navy has been truly designated as a "great American university," in which nearly 50,000 men and youths are being trained in that "respect for constituted authority" to the lack of which, as much, perhaps, as to anything else, are to be attributed the more serious of our social, commercial and political evils.

We believe in an adequate navy, also, because both at Annapolis and in the subsequent routine of official life, the service has developed a body of men who reach a higher professional standard of ethics than can be found, probably, in any of the professions to-day. In his ever-ready subordination of self-interest to the interests of the service, the naval officer stands for the finest traditions of the professional man; and in the matter of zeal and sobriety, we believe that he has reached a higher mark than any recorded in the past history of the United States navy. We speak of sobriety from the standpoint of intimate knowledge, for it was the Editor's privilege recently, as guest in the wardroom mess of one of our ships, to note that, when the wine was served, one-half of the glasses were turned down—this, mark you, on the score that it tended to efficiency.

Lastly, the SCIENTIFIC AMERICAN stands for an adequate navy, because the national funds expended on the construction of ships and their equipment have served to originate and keep alive not a few of the industries of the country. But for the work afforded by the contracts for new ships for the navy, some of the finest shipyards in the country would have closed their gates, and the death blow would have been given to our all-but-defunct merchant marine.

The Business Management of the Navy

By G. v. L. Meyer, Secretary of the Navy

THE essentials of administration are organization, co-ordination and efficient methods.

At the end of the previous administration a beginning was made in consolidating the shops at the navy yards. Under the old system, in existence for many years, each bureau had its own shops and its own workmen. Work is now done for any bureau in general shops.

In order that the head of the Navy might be informed and have responsible expert advice, and coordinate the efforts of the bureaus, an organization was put in force December 5th, 1909, with the knowledge and approval of the President, by which four aids were appointed and the bureaus were grouped in divisions of Operations, Material, Personnel, and Inspections. The Aid for Operations has charge of movements of ships, grouping into fleets and squadrons, and preparation of war plans and strategic studies. The Aid for Material studies the requirements for repairs and alterations and advises the Secretary as to whether the work in the various bureaus is being co-ordinated and expedited. The Aid for Personnel keeps posted as to the officers and men, and is always in touch with conditions at Annapolis and the training stations.

The Division of Inspections, reporting direct to the Secretary, co-operates with the Division of Material in finding out the condition of the ships and the necessity for repairs, and advises also as to whether repairs and alterations requested will be worth the expenditure of money in final military value. A part of this work was formerly done by the Board on Construction, composed of the individual bureau chiefs. Under this board also came the final determination of the qualities of new ships. In the present organization, the designs and general military characteristics of ships are determined in a more rational and up-to-date manner. The general military features required are recommended by the General Board and are referred to the Bureau of Construction and Repair. In case the general requirements asked for cannot be met, they are modified or changed to suit what may be accomplished on a given displacement. After the sketch plans are ready, sea-going officers from the fleet and other sources go over these designs, criticise and suggest improvements The modified requirements go back to the Bureau of Construction and Repair for change in the outline plans, which are again submitted to scrutiny. The whole matter has thus been thoroughly gone over and the objections, criticisms and suggestions of the sea-going officers, and the opinions and knowledge of the technical officers have been assimilated. The final designs represent both the best technical knowledge and the sea-going experience of our expert officers. The best naval advice is now placed in the hands of the designer without his efforts being required to reconcile many conflicting opinions, and at the same time the officer who will have to fight the ship finds that his advice is not ignored. This method has proved an inspiration to the naval architect, and the present designs of battleships are far in advance of all former attempts.

The Department has been for some time studying the new systems of modern management in commercial establishments, both in this country and in England, with a view to introducing such parts or features of it as might be applicable to our navy yards. Civilian experts who visited the vessels of the fleet found that the highest type of scientific management now exists in our battleships, and they have expressed to me the greatest admiration for the progress so far made and the excellent results accomplished. They found the Office of the Director of Target Practice a fine example of a planning office.

Some form of central planning will probably be added to the present organization, shop methods will be improved, and better determination of the use of machine tools and the efforts of the individual workman will be sought. The Department hopes to secure the best features of successful management and adapt them to navy yard requirements, thus cutting out wastes in time and by better methods securing increased production, with mutual benefit to the government and the workmen. If the energy of the workmen is wasted or is not efficiently applied, the elimination of the conditions producing such waste of good energy would be beneficial alike to the government and its employees; for both should share in the benefits of increased production.

The Division of Operations has drawn up a new organization for the fleet, to consist of 21 battleships, assigning one to the Commander-in-Chief, leaving five ships in each of the four divisions of the battle fleet. But one ship of each division will be at a navy yard for general repair, the other ships coming to the yards only for docking or minor emergency repairs twice each year. The efforts to make the ships as self-sustaining as possible have been encouraged, with the result that the work at the navy yards has been reduced. The carrying out of these two business-like features in handling the fleet will show more clearly the wisdom of recommendations made last fall that we give up a number of our smaller and unrequired navy yards.

One of the chief causes of great expenditures in the Navy is the excessive number of navy yards. We have on the Atlantic Coast nine navy yards, where in several instances, money has been expended lavishly, which would not have been the case if the strategic and economic point of view only had been considered.

Last year, as a beginning, it was recommended to Congress that several stations be abolished, which would have brought about a saving, irrespective of the price which the government might have obtained for these properties, of an annual maintenance expense of $1,600,000.

Criticism has been made for my not having recommended the abolishment of any of the Eastern yards; but the reason was that, for the present, the dry docks in the Eastern yards are a necessity to the fleet. The Eastern yards are located at Portsmouth, Boston, New York, Philadelphia and Norfolk, and it might be well to include Charleston. It has been sometimes stated that not more than three or four of these navy yards will be actually necessary, preserving, however, the use of all the large docks for government purposes. The question as to which of these yards should be maintained and which abolished is so important that it should be thoroughly considered by an unbiased board of experts, having in mind not local interests but only those of the fleet; as the yards exist for the fleet and not the fleet for the yards. As navy yards have no defensive facilities, the army must be consulted as to their protection and defense; consequently, the consideration as to which of these six yards are necessary to the navy from an economic and strategic point of view has been left to a joint Army and Navy Board to determine. On their report will be based my recommendations to the President as to the necessity of these yards, and as to which should be developed and continued.

When the Panama Canal opens, and the fleet spends probably an equal amount of time in each ocean, the work for the Atlantic yards will be much reduced and it will be even more evident that fewer will be needed. By a proper reduction in navy yards, there would be a vast saving of money in maintenance, probably three to four millions a year, and a realization of funds from the sale of real estate. If this is not done Congress must assume the responsibility. The great importance of the Caribbean Sea as a base of future naval operations, consequent on the completion of the Panama Canal, is now well realized. It is the plan of the department to have a naval base in the accessible and suitable harbor of Guantanamo, Cuba, on the direct route to Panama, which is some 700 miles from the Canal, and capable of harboring a fleet of 50 or more men-of-war. With a fortified entrance to the canal, a reasonably strong base at Guantanamo, and a torpedo base at Key West, our fleet will be able to utilize its full strength for attack or defense in the Caribbean, and the Gulf of Mexico will be as safe as an inland lake.

It is important, during battle maneuvers in peace, or a period of real hostilities, that a vessel should not be called upon to return thousands of miles in order to effect urgent repairs. These can be more easily and economically done by the development of Guantanamo as a limited docking and repair station.

It is the intention to develop Pearl Harbor, San Francisco Bay, and Puget Sound in order that the entire fleet may be maintained at times on the Pacific Coast.

The Department has been working for some time with the President's Commission on Economy and Efficiency toward introducing better business methods in correspondence, purchases and other details within the Department itself. The introduction of more economical methods in the departments and at navy yards will be facilitated by the new system of accounting which has been established within the last year in the Department and at the navy yards. It is now possible to get accurate trial balances, follow the cost of work, and determine with a larger degree of accuracy just what the navy's money is being spent for.

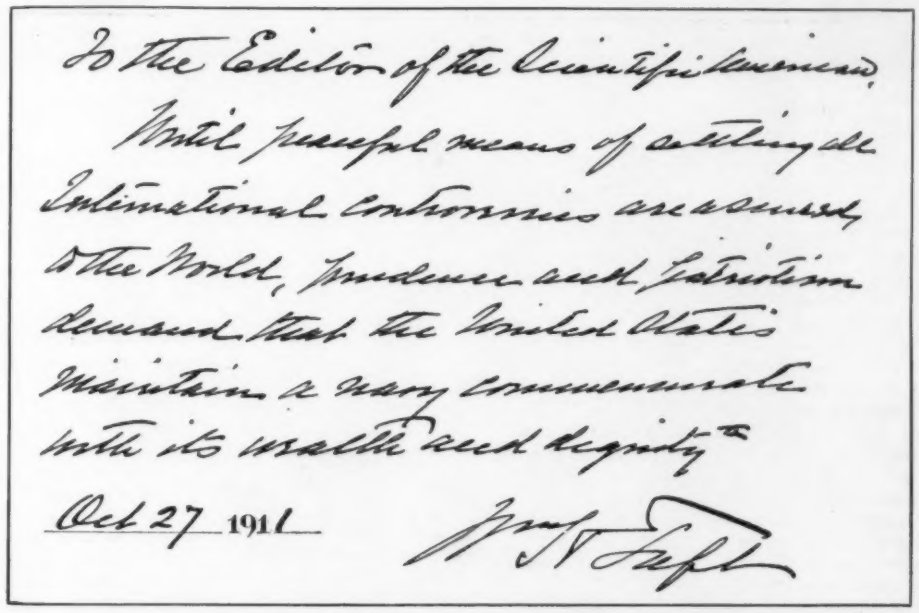
It is proposed, also, to reduce to the smallest limits the number of articles manufactured in navy yards, and to buy in open competition, whenever possible, all articles which can be properly and more cheaply made by commercial establishments. Naval specifications have recently been simplified and conform more to commercial usage, thus resulting in increased competition and lower prices to the Navy.

The occasional building of a battleship or vessel of a special class in a government yard, in order to demonstrate cost, is valuable and instructive, but should be avoided when a large saving ($1,500,000 on a single battleship) can be made. On account of the restriction made by Congress in the Naval Act of June 24th, 1910, by which it was provided that one of the battleships therein authorized must be constructed in a government yard, this saving can not be effected.

The question of docks for our larger vessels has been, until lately, a serious one. It looked for some time as if our latest ships, such as the "Arkansas" and "Wyoming," would be finished before any dock would be available to clean their bottoms and have them ready for their trial trips. To provide against this, vigorous action was necessary and was taken.

Dry Dock No. 4, at the Brooklyn Navy Yard, will now be completed in January, 1912, and Dry Dock No. 3, at Norfolk, lengthened to 700 feet, was finished in September, 1911. The Pearl Harbor dock and the large dock at Puget Sound, which will accommodate ships of the "Wyoming" class, are being pushed, and the latter is expected to be ready in March, 1912.

(Continued on page 517.)



To the Editor of the Scientific American,

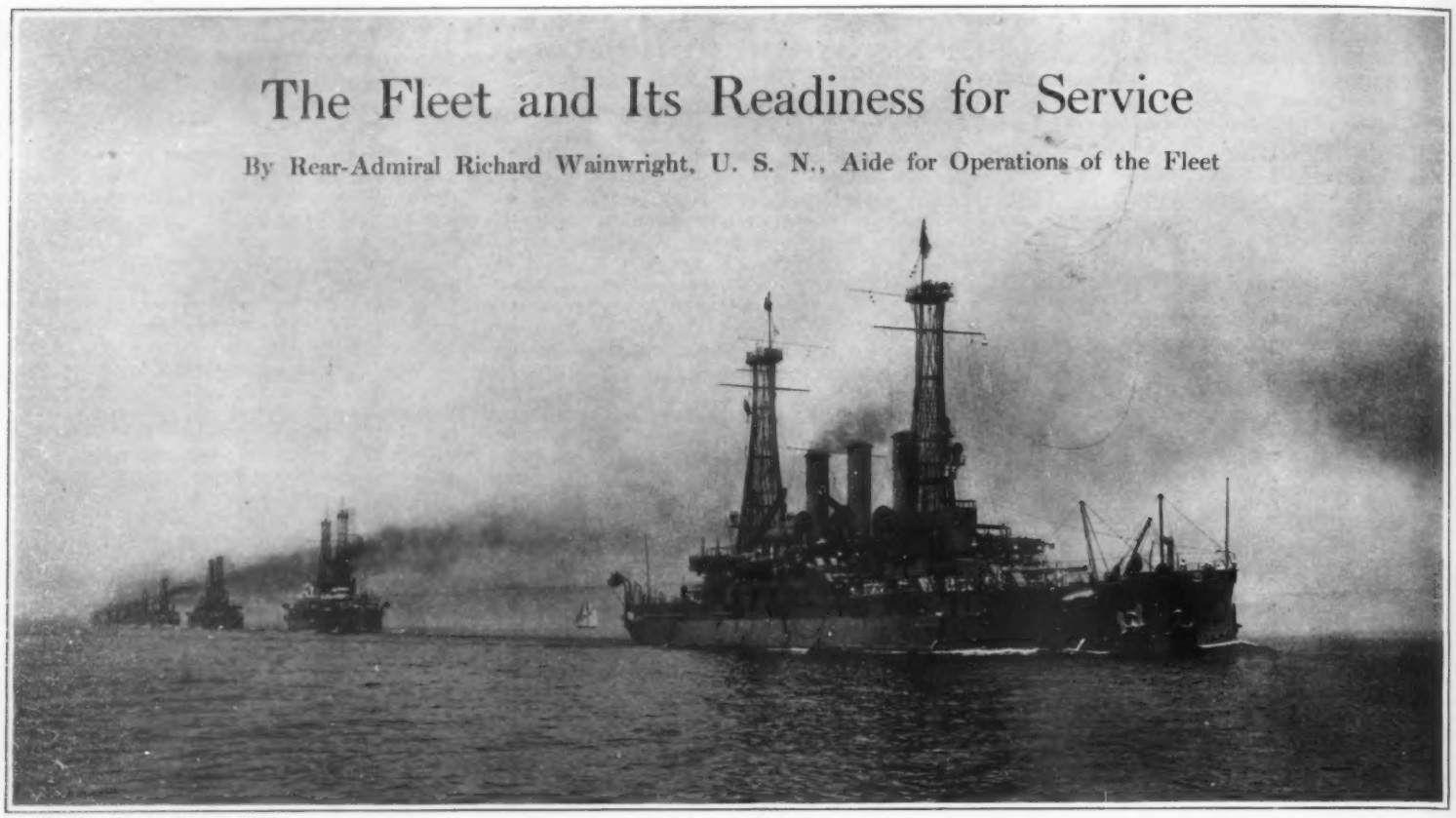
Until peaceful means of settling all International controversies are assured, the World, Prudence and Patriotism demand that the United States Maintain a Navy commensurate with its wealth and dignity.

Oct 27 1911 Wm H Taft

LETTER FROM PRESIDENT TAFT, COMMANDER-IN-CHIEF OF THE UNITED STATES NAVY

The Fleet and Its Readiness for Service

By Rear-Admiral Richard Wainwright, U. S. N., Aide for Operations of the Fleet



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PRE-DREADNOUGHT SHIPS OF THE ATLANTIC FLEET STEAMING IN COLUMN

THE strength of the fleet is commonly measured by the number of battleships and other fighting units on the Navy List. In a way this is correct and yet it may lead to serious error. It is safer to regard the number of battleships, armored cruisers, scouts, destroyers, etc., as only the potential strength, since the efficiency of the fleet, its ability to proceed promptly where needed and engage and overcome an enemy, depends upon many other things than mere ships.

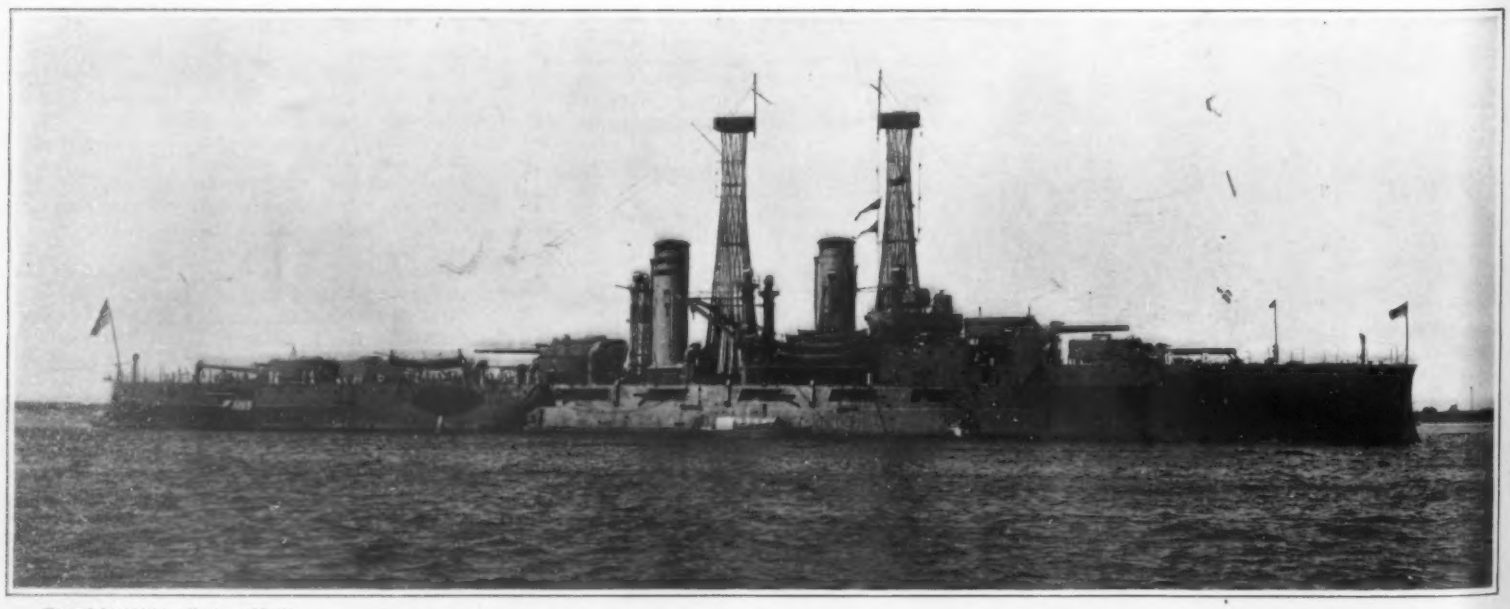
It is pertinent to remind the reader that battleships, and even the guns they carry, require years to build, that fighting ships can no longer be built or improvised after the outbreak of war, that officers and men can no longer be recruited from the merchant marine and quickly converted into naval crews, and, therefore, a nation to be ready for war must prepare in time of peace, and if not prepared can have small hope of victory over an enemy more wisely administered. The parable of the wise and foolish virgins is nowhere more applicable than with a naval force. These facts are so often lost to sight, even by many in high places, that it is well to mention them here as a preamble to a discussion which would not be understood, or if understood would fail to carry conviction, if they were not borne in mind.

The numerical strength of our fleet, as compared with other leading naval powers, is shown in the tables on page 532.

For several years past only about sixteen battleships have been kept in active service, the remaining vessels of this class, together with a number of ships of less importance, being out of commission for overhauling or in reserve for want of a sufficient number of officers and enlisted men to man them. On July 1st, 1911, the battleships in full commission were increased to twenty and shortly afterward to twenty-one, while all battleships built, thirty-one in number, will, about the end of this year, be either in full commission, or in reserve with sufficiently large crews to keep them in readiness for service. This great increase in the strength of the fleet is best shown by a comparison of the number of battleships and armored cruisers that were in full commission or in reserve, ready for active service, on May 1st, 1910, and the number that will be in readiness about the end of this year, when the reorganization of the fleet being effected by Secretary Meyer will have been fully realized. A similar increase in the effective torpedo fleet, and to a less extent other vessels, has been made; but the most significant fact is of course the increase from 19 to 31 battleships in condition for active service as regards material. A second and no less significant fact is that this large fleet is being created and maintained at a less cost for the entire naval establishment than formerly. The reasons for this are numerous, but the most important may be briefly stated here.

	May 1. 1910.	Dec. 31. 1911.
Battleships in active service.....	16	21
Battleships in reserve, ready for service	3	10
Armored cruisers in active service....	10	8
Armored cruisers in reserve.....	0	2

The most valuable lesson learned from the voyage of the battleship fleet around the world in 1908-1909 was that naval vessels may be practically self-sustaining in matters of repairs, provided the personnel is of a high standard. This fact is the basis of the reorganization lately put into effect, which makes possible the maintenance of the entire fleet in readiness for service. Before the reorganization it was customary to employ ships' crews to only a comparatively small extent in repair work. Vessels once placed in commission were habitually kept actively employed, with frequent visits to the navy yards for necessary repairs, until they deteriorated to such an extent as to require an extensive overhaul, when they were placed out of commission and turned over to the navy yard forces. During their period of commission



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Length, 518 feet 9 inches. **Displacement,** 22,060 tons. **Speed,** 21.5 knots. **Maximum Coal Supply,** 2,670 tons.
Armament, ten 12-inch, fourteen 5-inch. **Armor:** belt, 12-inch; turrets, 12-inch. **Complement,** 938 officers and men.

U. S. S. "DELAWARE." THIS TYPE WITH CENTER-LINE TURRETS HAS BECOME STANDARD IN THE WORLD'S NAVIES

much repair work not deemed of immediate importance was permitted to accumulate. This practice resulted in the ships not being in the best condition during the latter part of their commission; in expensive navy yard repairs during their active service; in extremely high cost of general overhaul and refitting after being placed out of commission; and, what is of the greatest importance of all from the viewpoint of preparedness, in the loss of ships to the Navy for anywhere from two to five years during their period of overhaul. In short, the old methods were extremely inefficient and wasteful. Under the system lately adopted ships will not be placed out of commission until they become obsolete and useless for war purposes. They are kept in efficient condition by their own crews and the navy yard work on them is limited to that clearly beyond the capacity of the crews.

The battle fleet is organized in divisions. Each division contains five ships of like or nearly similar tactical qualities. Four ships are required to be ready for service, while the fifth ship is allowed to lie at its home yard for overhauling and repairs by the crew, assisted as far as necessary by the yard force. The ships of a division are given this overhaul period in rotation, or each has about two months' uninterrupted time for repairs once each year. The net result of this is that in a fleet of twenty ships, sixteen are kept ready for service, and the remaining four are in a condition nearly approaching readiness.

Repair work done at a navy yard is very expensive and generally is not of better quality, if as good, as work done ence in cost is very greatly in favor of the ship's force, since the pay of the by a ship's force. Obviously the differnaval personnel is the same, whether it does the work or stands by and watches the navy yard force do it. As a general rule no one can know the needs of a ship as well as her officers and crew, and no other set of men is as capable as they of doing their ordinary repair work efficiently and economically. But, aside from these considerations, it is essential from a military point of view that the ships' officers and crews shall be habituated to this work in order that they may be able to maintain the fleet in an efficient condition in time of war, when there may be no navy yards at hand. Furthermore, of equal importance is the fact that ships may be kept in practically constant readiness for battle when repairs are habitually taken in hand and completed as rapidly as the necessity arises; while, if a navy yard is depended upon, repairs are allowed to accumulate, and when taken up by the yard require much time to complete.

As stated before, the strength of the fleet and its readiness for service depends upon many other things than mere ships. One of the most important factors is that of keeping all the units in readiness as regards material, as was dwelt upon somewhat at length in the preceding paragraphs; and a second fundamental requirement is that the personnel, both officers and men, must be competent and zealous in their work. Given these two fundamentals, there remain, before the fleet can be called efficient, the constant training of officers and men in their duties, the maintenance of a high *morale;* the inculcation of habits of high moral, physical and mental discipline; the attainment of the highest possible efficiency in gunnery and engineering; and finally, the amalgamation of all the units of the fleet into a composite whole capable of responding to the will of a practised commander-in-chief.

The question as to whether the fleet now meets these conditions and requirements depends upon what are regarded as the standards of efficiency and readiness. In matters of naval preparedness and efficiency the strength of a fleet is ordinarily measured by comparison with those of foreign powers. This method often leads to erroneous conclusions, for, as history shows, the true strength of a fleet can never be accurately determined except by the supreme test of war. The method that tends to the highest state of efficiency is to keep before us a standard of perfection, which if impossible, leads ever to constant improvement.

One of the most potent factors for steady improvement is competition, and to it much of our present efficiency in gunnery and engineering may be attributed. The spirit of competition not only leads to constant efforts on the part of the personnel to excel with the instruments placed in its hands, but stimulates the inventive genius of those charged with the making of the instruments, so that there has been a continual advance in the power and accuracy of guns as well as in the rapidity and expertness of their use. This is exemplified by the remarkable improvement in our gunnery since the Spanish-American war. At that time our fighting range was only two to four thousand yards, and a twelve or thirteen-inch gun was fired once in about three minutes; now, our target practice is carried out at a range of ten to twelve thousand yards, and the heavy guns fire two shots per minute; and with this advance in range and rapidity there has been a still more remarkable improvement in accuracy.

The advance in engineering efficiency has been as striking, and almost, if not quite, as important as the advance in gunnery. The reliability of the engines, as shown by full speed trials immediately after long cruisers, is of vital importance, and skill in firing, with attention to other details, has increased the steaming radius of the fleet from 25 to 40 per cent.

The cruise of the battleship fleet around the world did more than any other one thing to mold our fleet into shape; before that time the fleet may be said to have been an aggregation of units; but the cruise, with its attendant constant exercise in fleet tactics, made these units into one machine-like body. In short, the fleet on this cruise found itself. Since then, more than ever before, attention has been given to tactical and battle exercises, frequently under conditions simulating war. This more than anything else, except gunnery proficiency, insures readiness for battle. Even the best of ships would meet defeat if incapable of being handled effectively as a fleet.

Twice each year the battleship fleet, the torpedo fleet, and all other vessels available, are concentrated for joint maneuvers and battle exercises under the direction of the commander-in-chief, who thus gains the experience and practice necessary for his final training in the art of war. At other times each year the commanders of divisions of the fleet are given the opportunity to cruise and exercise their commands independently in order to gain experience which will fit them for succession to the command of a fleet.

As previously mentioned, those battleships and other vessels which cannot be kept in full commission, owing to a lack of available men, and to the considerable increase of cost involved, are being organized into a reserve fleet which, as far as their material condition is concerned, will be at all times ready for active service. These vessels are being provided with reduced crews to keep them in condition, and to serve as a nucleus of the full crews which, in the event of war, will be made up from the officers and men employed in time of peace at the shore stations, from the naval militia, and by the re-enlistment of men of previous naval training. This is a long step in advance in the matter of preparedness over the conditions which formerly existed.

The principal requirements of the fleet at present, without considering any increase in its battleship strength, are:

(1) The gradual replacing of worn-out or obsolete vessels by newly-constructed ships designed to efficiently meet the needs of the service.

(2) The provision of additional auxiliary vessels, repair ships, supply ships, colliers, tenders to torpedo fleets, tenders to submarines, transports and hospital ships.

(3) Additional scout cruisers, destroyers and submarines.

(4) The organization of an adequate naval reserve.

Battleships have a useful life of about twenty years, during the first half of which they may be considered eligible for the first line, or the main battle fleet, and during the latter half for the second line, or reserve fleet. The comparatively short life of ships is due not so much to deterioration as to the rapidity of development of science and the arts, which renders ships obsolete after ten to twenty years. As a case in point, compare battleships of the "Oregon" class with those of the "Delaware" class, the former launched in 1893 and the latter in 1909. There is not the slightest doubt that one "Delaware" could defeat in action a whole division of "Oregons," or could destroy the entire American fleet of the Spanish-American war. Thus it becomes necessary to replace these obsolete vessels and to relegate them to the coast defense and finally to "scrap" them, use them as targets, or otherwise dispose of them to the best advantage.

Auxiliary vessels are absolutely necessary for the maintenance of a battle fleet. Some such vessels have been provided, and additional ones must be obtained from the merchant marine when war becomes imminent. In this connection our merchant marine is deplorably small, and therefore the Navy must be provided with a larger number of regular naval auxiliaries than would be necessary or desirable if enough merchant ships were available.

The necessity for additional scout cruisers, of which we possess only three built for that specific use, destroyers and submarines, is apparent from an examination of the tables on page 532, showing the fleets of the several powers A battleship is dependent largely upon its scouts and destroyers for protection against torpedo attack as well as for the discovery of and attack on the enemy's fleet.

The creation of a naval reserve of officers and men is urgently necessary. The reserve should be composed of men who have had experience on board naval vessels. Thousands of such men pass each year from the Navy into civil life, and while it is expected that a large proportion of them will re-enlist in a national emergency, they should be formed into a reserve in time of peace, so organized that in an emergency they could be assembled at appropriate rendezvous and the reserve fleet manned without undue and possibly fatal delay.

Finally, the whole nation must be awake to the necessity of naval preparedness as a preventive of war. It has been well said that our nation is warlike, but not a military one. History bears this out, and it is a fact that all our wars have cost us excessively in life and money because of our unreadiness. Wars are usually of short duration, but preparation is long, and under modern conditions adequate preparation after war breaks out is well-nigh impossible. Our nation leads all others in its advocacy of arbitration. Our propositions are received with respect because of our strength, both actual and potential. To-day our interests touch with those of other nations in all parts of the globe, and while good faith and high principles have greater world force than ever, the time has yet to arrive when our national policy, even our national safety, can be held secure without armed forces, and of these an efficient battle fleet is indispensable.

(*Continued on page 532.*)

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The operations of a fleet are directed mainly by signals from the bridge of the flagship. In the above photograph, at the end of the bridge is seen a semaphore, and above the rail is a signalman with two flags; each of these sends "wig-wag" signals. The signal officer and a signalman are at the rail reading signals from another ship through telescopes.

THE SIGNAL BRIDGE OF A BATTLESHIP

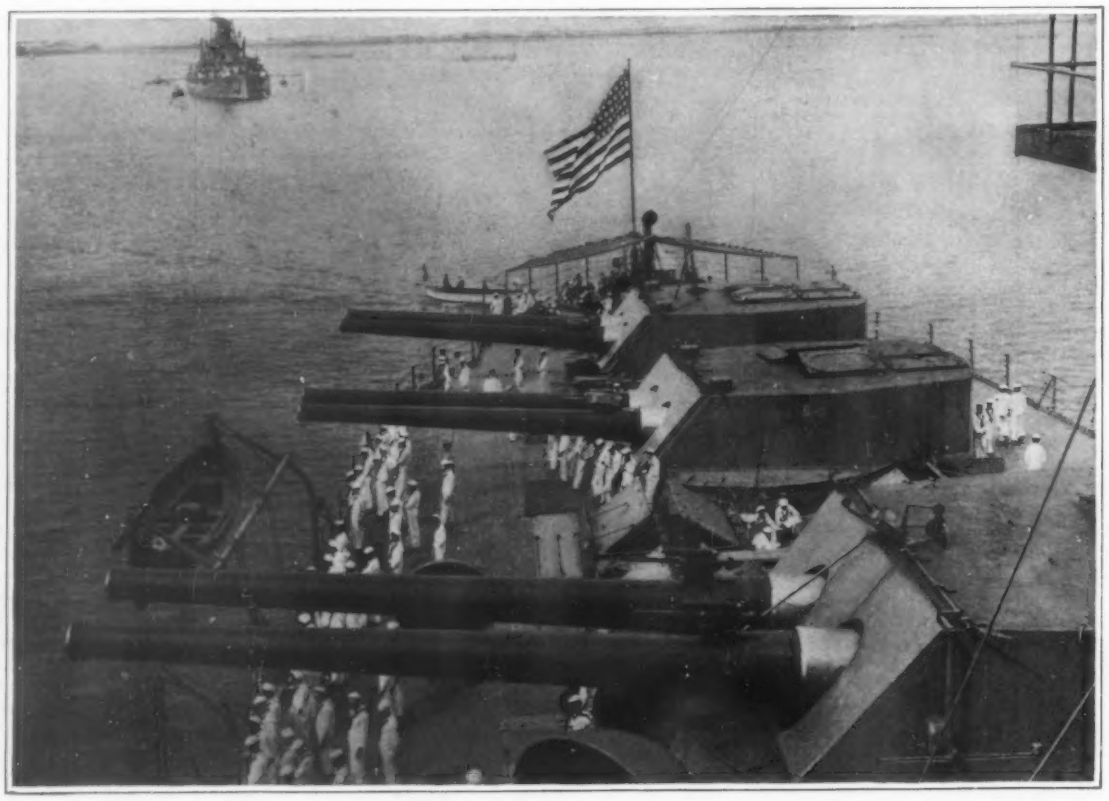
Influence of the United States on the World's Battleship Designs

Our Plan of Placing All Turrets on the Center-line Has Become the World's Standard

By Rear-Admiral R. M. Watt, U. S. N., Chief Constructor and Chief of Bureau of Construction and Repair

IT is a well known engineering principle that any design of the first magnitude must be a development of previous practice and based on features gathered from the four corners of the technical world. To attempt to trace the origin of many of these features would be a task for a historian and the result would be of small value except as a matter of academic interest. In a broad way, however, the history of shipbuilding and designing in the United States shows numerous fields in which Americans have been pioneers or instruments in the highest development of the ideas of others.

The well known inventive genius of the American can be recognized as a basic influence in myriad mechanical details incorporated in the great ships of war or peace of all the maritime nations. These details, though great in their final result, cannot be considered as a direct influence on the design of the individual ship. This influence, however, can be found even in the early history of this country when the American clipper ship was the fleetest sailer on all the seven seas. From this point to the present day the same influence can be traced through such great events as the marine application of the steam engine; the development of the armored revolving turret for the mounting of heavy guns; the application of electricity to all auxiliary power purposes on board ship; the appearance of the American type of the modern submarine, which, in its original form or as a basis for further development, is found to-day in the navies of England, Japan and Russia; the introduction on war vessels of the many comforts and conveniences of modern life, thereby permitting the fighting personnel to be maintained in the highest state of physical and mental training. These and many others are features which, through internal and external sources, have influenced, by the agency of American designers, the present-day development of that great fighting machine, the battleship. In the consideration of this type, it is well to pass over the great events of previous years and the details of to-day and treat only of those features which, to the naval architect, give a ship an individuality of its own. Such a feature is what is now generally known as the "American turret arrangement" which it will be interesting to examine in some detail.



All the turrets of our later battleships are located on the longitudinal center line of the ships. This enables every big gun to be trained through a wide arc of fire on either broadside.

THE THREE AFTER TURRETS OF THE "NORTH DAKOTA"

A battleship has frequently been described as a machine whose output is fighting capacity. In the development of any new type of machine, one designer will emphasize some one feature or arrangement, while other designers considering other features of greater importance will make enlarged provision for them. With the advance of time and increased experience, there is a gradual adoption of a standard type of machine, to which all manufacturers more or less conform. It is the purpose of this paper to show that the designers of the war vessels of the United States *in their first all-big-gun battleship* adopted as the emphasized feature of the fighting machine, a battery arrangement which, after experiment with various other battery arrangements, is now generally accepted by the designers of all nations as the standard battery arrangement (of guns) for the all-big-gun battleship. In thus setting the standard battery arrangement of fighting vessels, the influence of the United States on the world's battleship design *cannot be overestimated.*

The armament—that is the guns upon the number and arrangement of which fighting capacity depends—is the most striking feature of a battleship. In the development of the all-big-gun battleship, the designers of the United States naval vessels at once adopted an arrangement of all turrets on the center-line of the vessel whereby at the forward end of the vessel number two turret fired over number one turret and at the after end of the vessel number three turret fired over number four turret. In this manner all guns were enabled to fire on each broadside, and naval authorities are practically agreed that not less than 85 per cent of the firing will take place in the arc forty-five degrees forward and forty-five degrees abaft the beam. This arrangement was adopted in 1906 by the United States in its first all-big-gun vessels, the "South Carolina," and "Michigan," and the all-turrets-on-center-line arrangement has been followed in all battleship designs for the U. S. Navy since that date.

Assigning what we considered undue importance to end-on fire, foreign designers adopted arrangements which gave them end-on fire by the sacrifice of broadside fire to such an extent that from twenty to thirty and more per cent of guns could not be fired on the broadside, where they would most often be required. It should be noted that every battleship of the all-big-gun type in the U. S. Navy can fight every gun on the broadside—a provision which does not obtain in any other navy of the world.

To-day, however, the wisdom of the "South Carolina" arrangement is generally recognized, and such arrangement is coming into general use in all armored vessel construction.

That the importance of the principle of center-line turrets is not merely the view of an interested American naval officer is proven by the following foreign comments.

In a paper on "The Armaments of Battleship," contributed by that pre-eminent naval architect, Sir William White, to the American Society of Naval Architects and Marine Engineers in November, 1910, he wrote:

"There are two positions for heavy guns which by common consent confer supreme advantages, and are always utilized. These positions are at the center line of the deck; one commanding right-ahead fire, with large arcs of horizontal training reaching well abaft the beam on each side; the other possessing corresponding command right astern and over large arcs of training reaching well before the beam. Until the 'Michigan' and 'South Carolina' were designed it was the general practice to mount one or two heavy guns—two in nearly all cases—in each of these positions. Superposed turrets were tried in some cases, and 8-inch guns were mounted in the upper emplacement; but this practice did not find much favor and may be considered to have dropped out of use. It was a new and bold departure in the 'Michigan' and 'South Carolina' to place two turrets in each of the supreme positions and to arrange for firing the guns in one turret over the top of the other turret. That arrangement proved successful, however, and has been largely adopted in recent ships of all navies. When associated with the mounting of guns in pairs this system permits the effective use of eight heavy guns; if three guns are mounted in each turret then twelve heavy guns can be given equal arcs of command, and all the guns can be used on each broadside. . . .

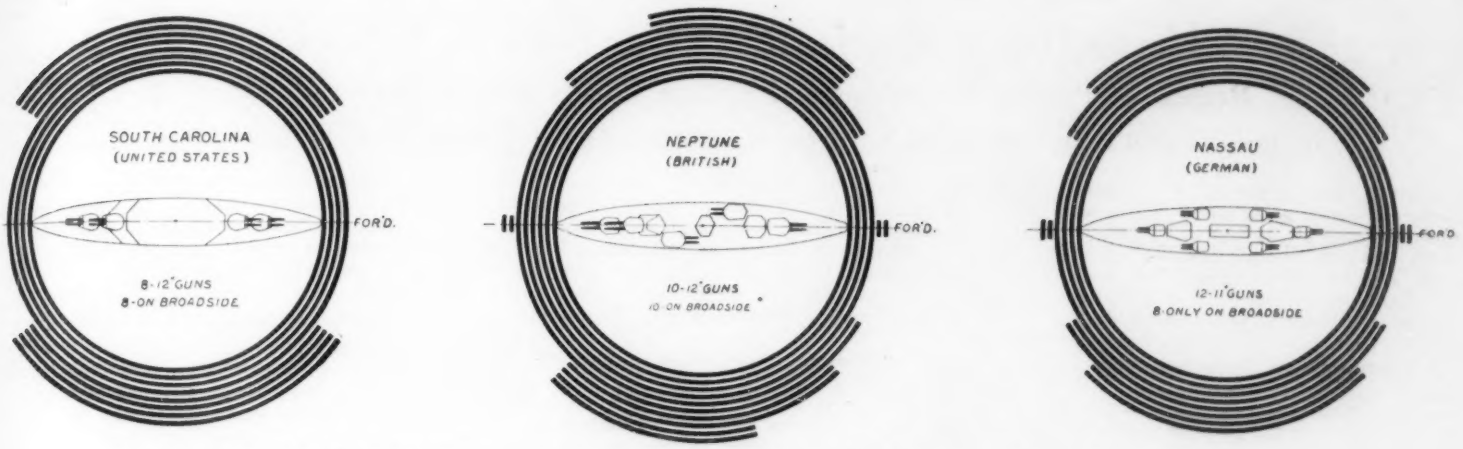
"Now there is a marked disposition to place all the heavy-gun stations at the center line of the deck, so that all the guns may be available on both broadsides. This is a return to a disposition adopted in the earliest British turret ships built nearly half a century ago. The 'Royal Sovereign' (1862) and the 'Prince Albert' which followed immediately after her, each had four turrets so placed. It may be noted that the United States Navy took the stand in this last movement, and further has the credit of demonstrating the possibility of associating powerful bow and stern fire with the maximum of broadside fire over large arcs of training, by placing some turrets higher than other and firing over the lower turrets on certain bearings."

In commenting on the above paper by Sir William White, *The Engineer*, published in London, says editorially in its issue of December 2nd, 1910:

"In tonnage value for effect obtainable, it is hard to believe that it is possible to improve on the arrangement, first adopted in the United States battleship 'Michigan,' of four twin turrets on the center line, the two inner turrets firing over the two end turrets."

In its annual comments on warship design, "The Naval Annual" for 1910, edited by Lord Brassey, says:

" . . . . The 'Michigan' and 'South Carolina,' of 16,000 tons, have a speed of nearly 19 knots and eight 12-inch guns, all mounted in pairs on the center line, the second and third turrets being on a higher plane than those at the extremities of the vessel, so as to allow of their guns pointing over the end turrets, enabling four guns to be directed right ahead and astern. Now, if they can be so fired without detriment to the outer gun positions, the design possesses the advantage that, with two guns less than our 'Dreadnought,' an equal broadside fire is secured. It only gives, however, an end-on fire of four guns against six. Another novelty in the 'Michigan' pair



The eight-gun "South Carolina" of 16,000 tons can deliver a more effective broadside than the twelve-gun "Nassau" of 18,500 tons displacement.

is the means whereby elevation is secured for observation, signalling, etc. Masts in some form are required. The tripod method was adopted in the 'Dreadnought.' It is not novel, having been advocated by Cowper Coles and applied to the 'Captain' for sailing purposes. It gave less interference with turret-gun fire than ordinary rigging. But the three iron masts forming the tripod are of great weight, and probably mainly on this account the Americans have, in the 'Michigan,' placed two masts constructed like an Eiffel Tower of steel lattice work. Though offering a comparatively large target, presumably it is expected that projectiles will pass through without doing great damage; but if the resistance is sufficient to explode a shell a different result may follow."

Jane's "Fighting Ships" for 1907, said:

"There is some good reason to believe that taking all things into consideration the 'South Carolina' type is the best all-big-gun ship yet put in hand."

Jane's "Fighting Ships" for 1908, referring to center-line battery arrangement, says:

" . . . . The disposition of artillery in the 'Delawares' is peculiar, all turrets being in the center line. There is little doubt that this design is superior to the echelon system in the matter of training. The British 'Invincible' class, though nominally able to bear all eight guns on either broadside, can only do so over a very limited arc of training, while every 'Delaware' turret has a fine arc on either side."

And again in 1910, on page 503 of Jane's "Fighting Ships," Captain William Hovgaard states:

"The ideal arrangement of the heavy gun-turrets seems to be the American, first adopted in the 'Michigan,' where two turrets are placed at each end of the ship in the center-line, the guns nearest amidships firing over those nearest the ends. By this disposition the guns obtain the maximum arc of fire, the position of the upper turrets is commanding and dry, the arrangement of ammunition rooms is simple, and ample room is left amidships for an efficient and well protected secondary and anti-torpedo boat battery. With turrets placed on the broadside or on a low level in the center-line between end turrets, these advantages will not be obtained, and notably the relative loss in arc of fire, as in case of the broadside turrets of the 'Dreadnought,' the 'Nassaus,' and the new French 23,000 ton battleship, will very considerably reduce the efficiency of the guns.

"If then we want to increase the power of the primary battery beyond that obtainable with the 'Michigan' arrangement, and without abandoning the said advantages, three ways are open:

"(a) A third twin-turret may be placed on the center-line at each end of the ship inside the two other turrets and firing over these.

"(b) The caliber of the guns may be increased.

"(c) Three guns may be mounted in each turret."

Commenting on the visit of the United States fleet to Europe, the *Journal of the Royal United Service Institution* for December, 1910, states:

"It may be of interest to recall that the two American dreadnought battleships, the 'Delaware' and 'North Dakota,' are vessels with a displacement of 20,000 tons, and in addition to their main battery, composed, like that of our own earlier dreadnoughts, of ten 12-inch 45-caliber guns, they also carry a more powerful anti-torpedo defence armament of fourteen 5-inch Q. F. guns, which for the most part are mounted in a central battery behind armor protection. All the big guns are on the center line of the ship, this being a characteristic feature of the turret arrangements in American designs, two of the turrets being raised above the others in order to obtain a sufficiency of right ahead and right astern fire and this method of placing the turrets is the one now adopted for our latest ships, as giving the advantage that all the guns can be fired on either broadside. Thus, while the 'Dakota' and 'Delaware' can bring all ten of their 12-inch guns to bear on either side, our earlier dreadnoughts including the 'St. Vincent' and her sisters, can only bring eight. On the other hand, the end-on fire of our ships is heavier."

It should be noted that the *wise* arrangement of the turrets of the 'South Carolina' and 'Michigan' was not the result of chance, but was adopted only after actual experiments on the monitor "Tallahassee" (then the "Florida") had proven that it was possible to fire a 12-inch gun over a turret without injury to the occupants of the lower turret. It is believed that the battery arrangement of the "South Carolina" and "Michigan" will remain a standard arrangement in the future, and that further increases in fighting capacity will be secured by increasing the caliber of guns, or by increasing the number of guns in a turret, or by both measures in the all-center line vertical echelon turret arrangement.

The Business Management of the Navy

(*Continued from page 513.*)

The width of the latest docks has been increased to 110 feet, the same as established in the locks of the Panama Canal.

Two contractors having failed to secure results with the New York dock, the second contract was ordered to be cancelled on account of no progress having been made, and competition for the completion of this important work was limited to the six largest firms of recognized engineering ability and financial standing. The contract, placed in November, 1909, under these conditions, is being well carried out and the great dock at the New York Navy Yard will be finished in January, 1912.

The large dock at the Boston Navy Yard was enlarged slightly, at a cost of only $15,000, so that it now can comfortably dock the "Florida" and "Utah."

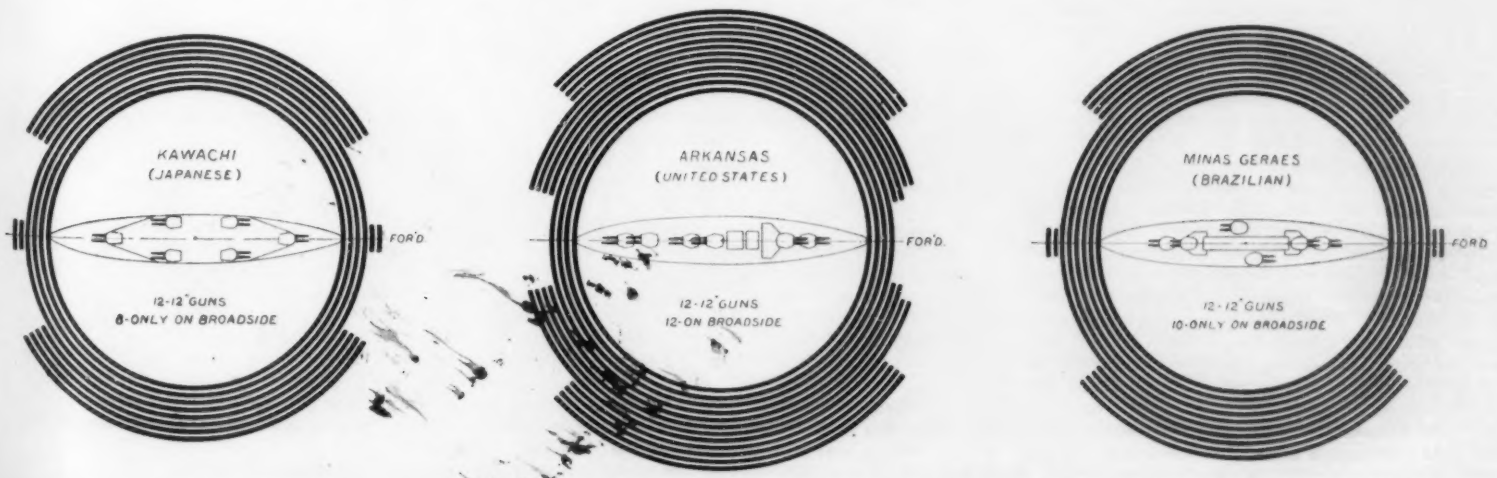
Competition, both in the fleet and at navy yards, has been a great factor in reducing the expenses of a growing fleet. The present high standard of shooting is due to the system of competition introduced some ten years ago. Comparison between the shooting in 1898 and to-day shows that to-day we are 1,200 times better.

Steaming competitions have lately been introduced, so that economy in the use of coal, oil, waste, and other supplies, and the efficiency in steaming, determine the ships' standing. The idea is that a ship must be able, first, to get on the battle ground quickly and surely; when she is there, she must be able to shoot rapidly and straight.

Instead of having seven store accounts we now have but one, which has simplified book-keeping and clerical work. The old Naval Supply Fund, which had a capital of $2,700,000, has been liquidated and this sum has been released to the Treasury for other purposes.

It is hoped that a correct personnel bill will be secured, by which the ages of our officers may be reduced and greater efficiency brought about. The bill recommended will produce captains from 45 to 48 years of age, and rear-admirals at 55 instead of about 60. It is also desired to add two vice-admirals and an admiral, in order that the commander-in-chief of our great battleship fleet should have a position commensurate in importance with his command, and that he should not be outranked, when meeting foreign fleets on special occasions, at home and abroad, by an admiral of a single ship or of an inferior navy.

In conclusion, let me add that the aim of this administration has been to introduce into the management of the navy modern, efficient business methods, to reduce correspondence and cut out red tape. Economies have been established and output increased. Nor has the department, in its efforts to reduce expenses, forgotten the paramount importance of the highest military efficiency and a preparedness for any emergency. To-day, when needed, it holds, to preserve the peace, a larger and more efficient fleet, at a smaller cost for upkeep. The changes in organization have justified themselves by results and are paying—the final test of all business management.



The "Arkansas" can concentrate on the broadside two more guns than the Brazilian "Minas Geraes," and four more than the Japanese "Kawachi."

Propelling Machinery for Naval Vessels

Review of Present Conditions and Future Possibilities in Motive Power

By Rear-Admiral H. I. Cone, U. S. N., Engineer-in-Chief and Chief of Bureau of Steam Engineering

THE advent of the turbine has greatly extended the range of speed at which vessels may be safely and continuously propelled by steam machinery. It is, therefore, particularly suited to high speed vessels.

In the older destroyers a sustained speed of 30 knots necessitated driving the reciprocating engine at or beyond its limit of safety and reliability. As a result the contract speed could rarely be maintained on service, and certainly not for any extended period of time.

To-day the steam turbines of our destroyers can be driven continuously at full power as readily as at the lower powers.

Next below the destroyer in the speed scale is the scout cruiser; of these we have three, the "Birmingham," "Chester" and "Salem," similar in design, except as regards their machinery installations. The "Birmingham" has reciprocating engines, the "Chester," Parsons turbines, and the "Salem," Curtis turbines. The contract trial speeds were, "Birmingham," 24.325 knots; "Chester," 26.52 knots; and "Salem," 25.947 knots, thus demonstrating, as in the case of the destroyers, the superiority of the turbine for development of high speed.

A rather unexpected result of our experience with these vessels on service has been the greater reliability of the reciprocating engine. In the case of this type of vessel, where the reciprocating engine is admittedly out of place, it was confidently expected that the turbine would demonstrate its superiority in this regard. Thus far, however, under similar conditions of service, the machinery of the "Birmingham" has required considerably less repairs than that of either turbine vessel, and of the three, the "Birmingham" has always been the one whose availability for service could most be relied upon.

Thus for the scout cruiser, while the turbine is the most suitable type of machinery, its superiority over the reciprocating engine is not so manifest as in the case of the faster destroyer.

As we descend the speed scale into the region of the more important naval vessels of medium speed, the turbine is still less clearly indicated as the best type of propelling engine. This is because of the relatively increased importance of its principal deficiencies which are:

(1) A tendency to disablement to a degree requiring repairs beyond the capacity of the ship's force, thus temporarily destroying the military value of the vessel.

(2) A lack of economy of steam consumption at the lower speeds, which affects the cruising radius of the vessel.

Regarding the first of these, there is a tendency to a rubbing and stripping of the turbine blading, due to the small clearances necessarily employed, the causes of which are sometimes obscure, and the prevention of which is accordingly difficult.

The re-blading of a damaged turbine can be done only at a navy yard, and requires the lifting of the casing and the rotor, which in itself is a considerable item. In our experience this work has seldom been completed within a month.

Improvement in design, greater experience with the operation of the turbine, and better facilities for its repair, will doubtless reduce somewhat the extent and importance of this trouble. But at present the reliability of the turbine in service must be considered as probably not as good in a medium or low-speed vessel as that of the reciprocating engine in its present development, with forced lubrication of its bearings.

Inferiority of the turbine in its economy at the lower speeds is probably inherent. At the cruising speed of a battleship, the reciprocating engine is 20 to 30 per cent more efficient than the turbine.

These failings of the turbine are due in a great degree to the conditions governing its use in naval vessels, and are not manifest in its other applications. When driven continuously at high-speed, as with electric generators, and, to a less degree, in high-speed passenger vessels, its efficiency as compared with that of the reciprocating engine is entirely satisfactory, and in a vessel the nature of whose service is such that the turbines can be kept warm during the short intervals between runs, the danger of stripping during the warming-up period largely disappears. The irregular movements of naval vessels, however, with their frequent periods in port with cold turbines and their considerable cruising at low speeds, impose handicaps on the turbine in these two respects.

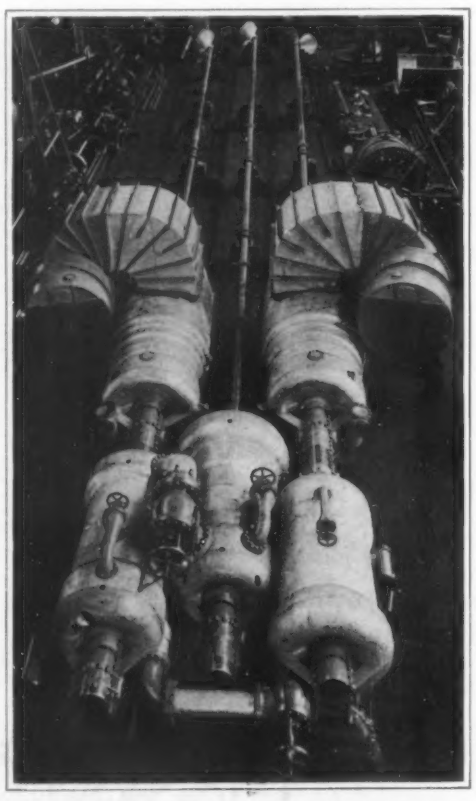
The peripheral speed of turbines for maximum efficiency should be not less than half the velocity of the steam. To secure this maximum efficiency within practicable limits of diameter of the turbine requires, ordinarily, revolutions per minute of from 1,500 to 3,000. These speeds are perfectly practicable for electric generators, but are unsuited to the marine propeller, whose efficient working requires revolutions, depending upon its diameter, of from 70 to 800 per minute.

There is presented, therefore, the problem of providing a method in which a high-speed turbine may be made to drive a slowly-revolving propeller, thus conserving both turbine and propeller efficiencies.

Two methods of accomplishing this are particularly prominent just now.

Reduction-Gear Drive.

The collier "Neptune," built by the Maryland Steel Company at Sparrow's Point, Maryland, has been equipped with reduction-gear machinery constructed by the Westinghouse Machine Company. This collier is a twin-screw vessel, displacing 19,300 tons, with a speed of 14 knots. Steam at a pressure of 200 pounds is supplied to a Westinghouse Parsons turbine for each shaft, each turbine developing about 3,600 shaft horse-power on 1,220 revolutions. Between the turbine and its propeller shaft is mechanical gearing which will reduce the propeller speed to 135 revolutions per minute at about 14 knots. The gear pinions are carried in floating frames supported by oil pistons in such manner as to effectually take up any irregularity in the gear cutting. The oil pressure on pistons is indicated on gages which afford a means of directly reading the tooth pressure, and thus calculating the power being developed. A novel feature of the installation is a provision for operating the propelling machinery from the bridge. The shop tests of the gearing for the "Neptune" have been very satisfactory. The gears have demonstrated an efficiency of transmission in excess of 98 per cent, and have run quietly for long periods with no apparent wear. There is no back lash on reversing.



The turbines, shafting and propellers of a triple-screw destroyer, assembled in the shops.

Extensive trials of the "Neptune" will be held.

Reduction gearing as installed in the cargo steamer "Vespasian" by the Parsons Company has successfully completed a year's trial, during which its durability has been tested under the severe conditions of weather in the North Sea during the winter months. The vessel has made 32 trips, a total of about 20,000 miles, carrying coal from the Tyne to the Continent and returning with water ballast. It is reported that during this time there has been no appreciable wear in the teeth of the gearing, and that there is practically no slackness apparent, although no provision was made of adjustment for wear. A noticeable feature of the installation has been the almost entire suppression of the tendency to racing of the engine, even in weather when the propeller has been entirely out of water.

Electric Propulsion in a Naval Collier.

In the naval collier "Jupiter," a vessel similar to the "Neptune," which is being constructed at the navy yard, Mare Island, California, there will be obtained a trial of a method of electric propulsion. A contract for this machinery has been placed with the General Electric Company. In this system it is proposed to install one turbo-generator running at a maximum speed of about 2,000 revolutions per minute, and delivering current with a potential of 2,300 volts to induction motors, one on each propeller shaft. The power from the turbine will be transmitted to the propeller shafts, electrically, with a speed reduction in ratio of 18 to 1. The efficiency of transmission is expected to be about 91 per cent. The water rate for this installation is stated to range from 12.15 pounds per shaft horse-power at 14 knots, to 15.55 pounds at 10 knots.

In the case of a battleship the proposed form of electric drive contemplates two turbo generators driving two motors on each of the two main shafts. This multiplicity of units combined with a pole-changing device on two of the motors, promises an economy close to the maximum at all speeds above 10 knots.

Comparing the electric with the mechanical reduction-gear it is at once evident that the latter has the superior efficiency of transmission. In the case, however, of a vessel in which economy at the lower speeds is required, the flexibilty of the electric installation, as outlined for a battleship, might overcome this disadvantage.

As with the scout cruisers, we will, therefore, probably have in service three similar colliers with different types of propelling machinery, the "Cyclops" being already in commission with an excellent installation of reciprocating engines, which on trial developed a horse-power on less than 1.5 pounds of coal per hour at full power.

Combination of Turbines with Reciprocating Engines.

The combination of a reciprocating engine working the steam from boiler pressure down to nearly atmospheric pressure, and a turbine which works from the exhaust pressure of the reciprocating engine down to the vacuum, is a particularly efficient one, because under such conditions each engine is working in the pressure range to which it is best suited. Such combinations are used with great success in power plants on shore and in certain moderate-speed passenger vessels, notably the "Olympic," "Titanic," "Laurentic," and "Otaki." Its principal value is in economy of steam consumption at full power in a medium speed vessel, in which case it probably gives a gain in economy over the reciprocating engine or turbine of not less than 10 per cent. In the case of naval vessels whose cruising speed requires only from 1/7 to 1/12 of full power, the advantage of this combination is not so impressive.

There is, however, a combination of reciprocating engine and turbine which has its maximum efficiency at the cruising speed. This consists in the use of a small reciprocating engine in a manner similar to that of the cruising turbine in a Parsons turbine installation. The reciprocating engine, whose size is limited to that required to pass the steam for the designed cruising speed, exhausts through the turbines. At higher speeds the reciprocating engine is disconnected. The weight of the reciprocating engine, and the space required, are less than for the cruising turbines, and it is probable that the engine will be less prone to disablement than the cruising turbine. The principal difficulty involved seems to be the design of the clutch connecting the reciprocating engine with the turbine shaft.

In another combination which suggests itself, and which, theoretically, has about the same efficiency, there is substituted for the reciprocating cruising element a small high-speed turbine connected by reduction gearing to the main turbine shaft.

The selection of machinery for a naval vessel at the present time, therefore, requires a careful consideration of a number of possible types. The line drawings on page 519 show the approximate appearances of systems which have been considered for a battleship.

Heavy-Oil Engine.

It now seems probable that none of the foregoing methods of propelling medium-speed naval vessels,

all of which are forms of steam machinery, will endure. This in consequence of the recent remarkable development of heavy-oil engines of the Diesel type in Europe. Hitherto, oil engines have not merited much consideration for large naval vessels on account of the limited power that could be developed in a single cylinder. An installation of any considerable power required a multiplicity of cylinders. Now, however, we are credibly informed that 1,000 horsepower has been developed in a cylinder about 33 inches in diameter with a 40-inch stroke, at 150 revolutions per minute, in a 2-cycle marine type readily reversible engine. This engine has a speed control that is satisfactory, and an economy of fuel consumption probably twice that of a steam engine. An experimental double-acting marine engine, with three cylinders, of about this same size, has been built to develop 6,000 brake horse-power at 150 revolutions per minute. In the development of the oil engine, the trunk piston is being abandoned and cross-heads and connecting rods used. It will, therefore, resemble the reciprocating steam engine, and our experience with the latter will prepare us for the operating and repairing of the oil engine.

As in the case of all first installations of whatever type, there will probably be disappointments in the first applications of the oil engine in marine propulsion, and it may be that further development of the engine may be found necessary prior to its extensive adoption. However, the superior economy of the oil engine, together with the elimination of the steam boiler and condenser will cause us to be patient in the face of a considerable amount of trouble.

The extent of the adoption of the oil engine by the nations of the world will be largely affected by the supply of oil available. We are in a particularly fortunate position in this respect, producing ,as we do two-thirds of the world's supply.

Use of Fuel Oil in Place of Coal.

In our new construction we are greatly extending the use of oil in steam vessels. All our new destroyers are oil burners, and it is hoped to extend its use to the larger vessels, including battleships. Some of the advantages of oil as compared with coal are as follows:

With oil an evaporation per pound of fuel greater than with coal in the ratio of about 14 to 9, and per square foot of heating surface in about the ratio of 10 to 8, is obtained. Fuel oil can be taken aboard readily without manual labor and without interruption to the routine of the ship.

Steam for full power in such a vessel can be maintained as readily as for low power. A vessel burning oil is capable of prolonged runs at full speed limited in length only by the supply of fuel. There is no reduction in speed due to dirty fires or to difficulty in trimming coal from remote bunkers.

There are no cinders and the amount of smoke can be controlled.

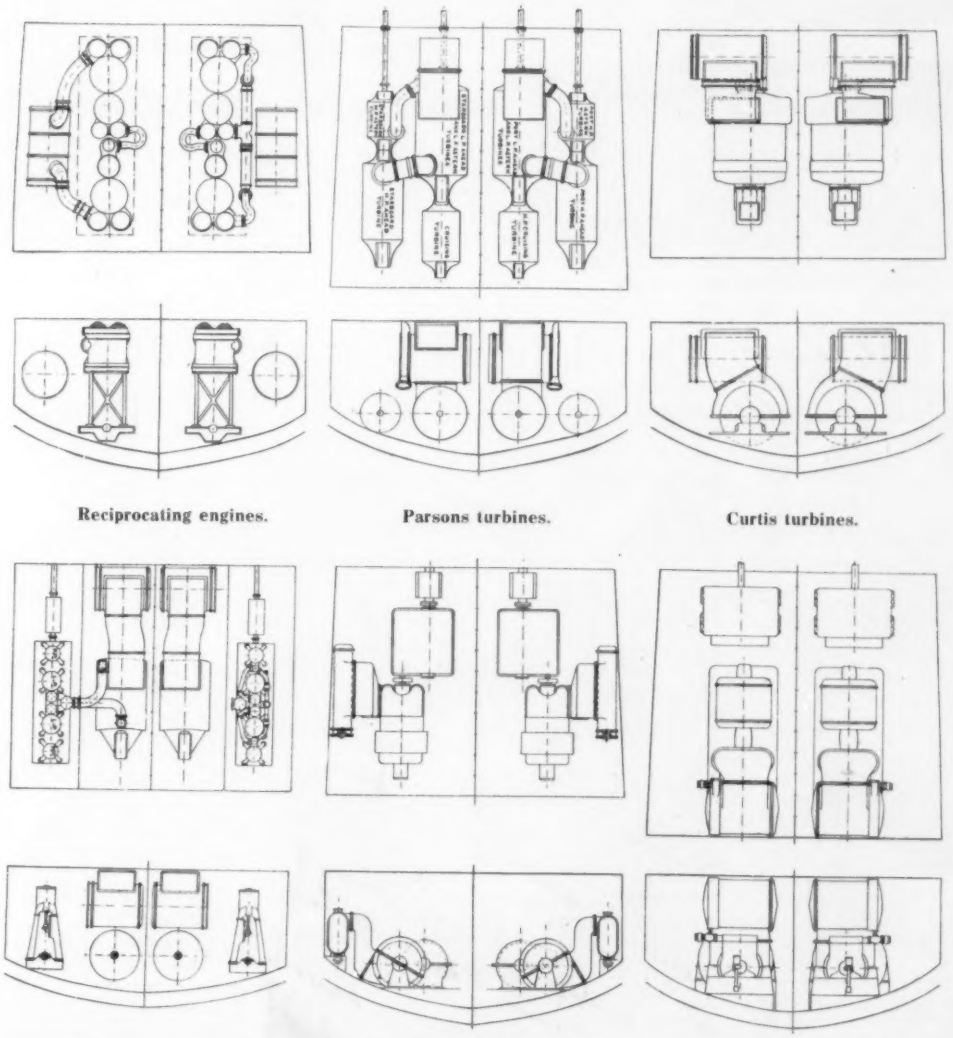
A considerable reduction in personnel is possible, the size of the fireroom force required being limited to that necessary for overhaul and cleaning of the plant.

The weight and space required for boilers is reduced, first, by the reduction in heating surface required, and second, by the shortening of firerooms, no space being required in front of boilers for handling fire tools.

Coal and ash handling gear is eliminated. This renders unnecessary the piercing of the hull for coal trunks and for discharges from the ash expellers or ash ejectors.

The stowage and handling of oil is much easier than of coal, and will result in a much cleaner ship and consequent increase in time available for drills.

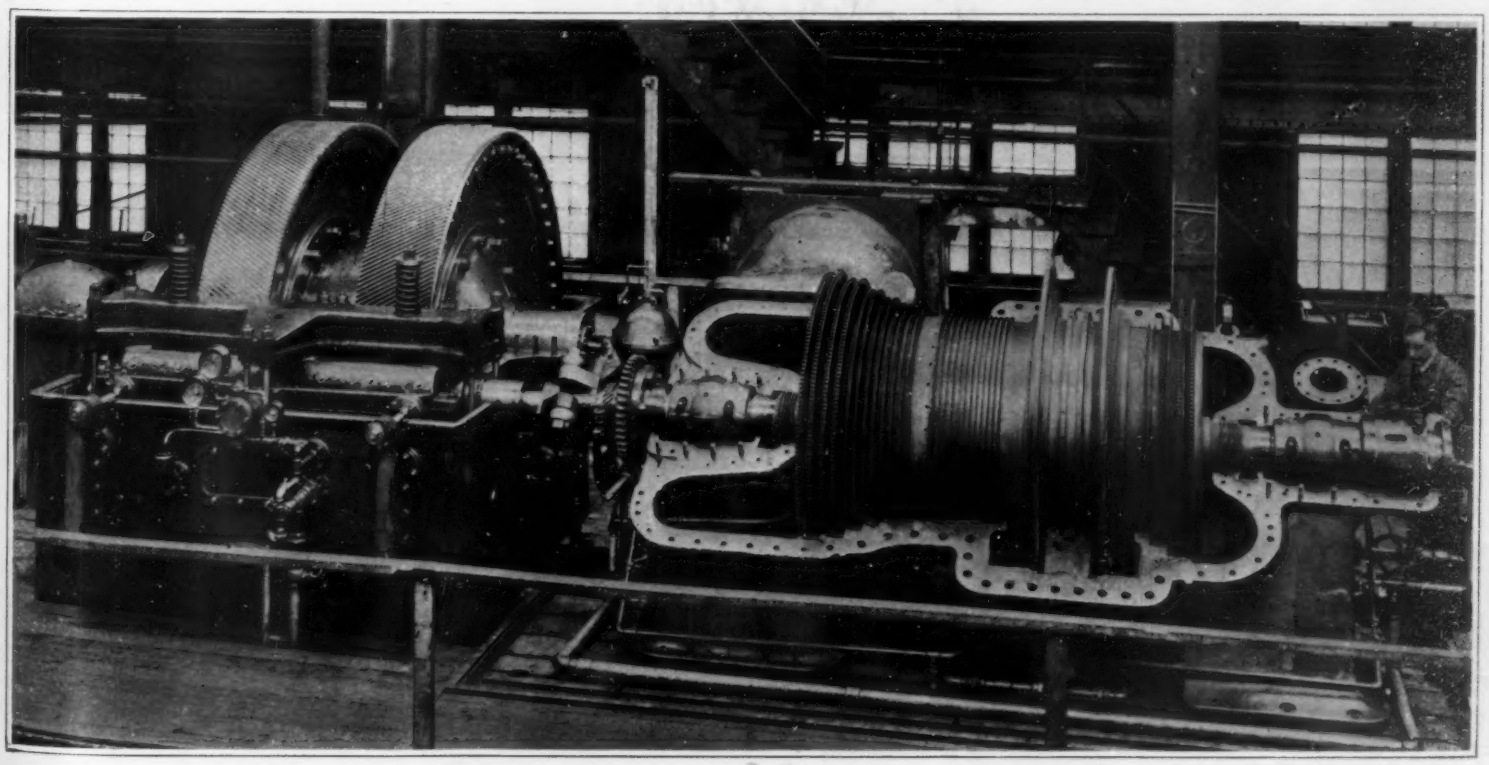
The mechanical supply of fuel to the boilers gives a prompt and delicate control of the steam supply, permitting more sudden changes in speed than with coal, which is a tactical advantage.



Reciprocating engines. Parsons turbines. Curtis turbines.

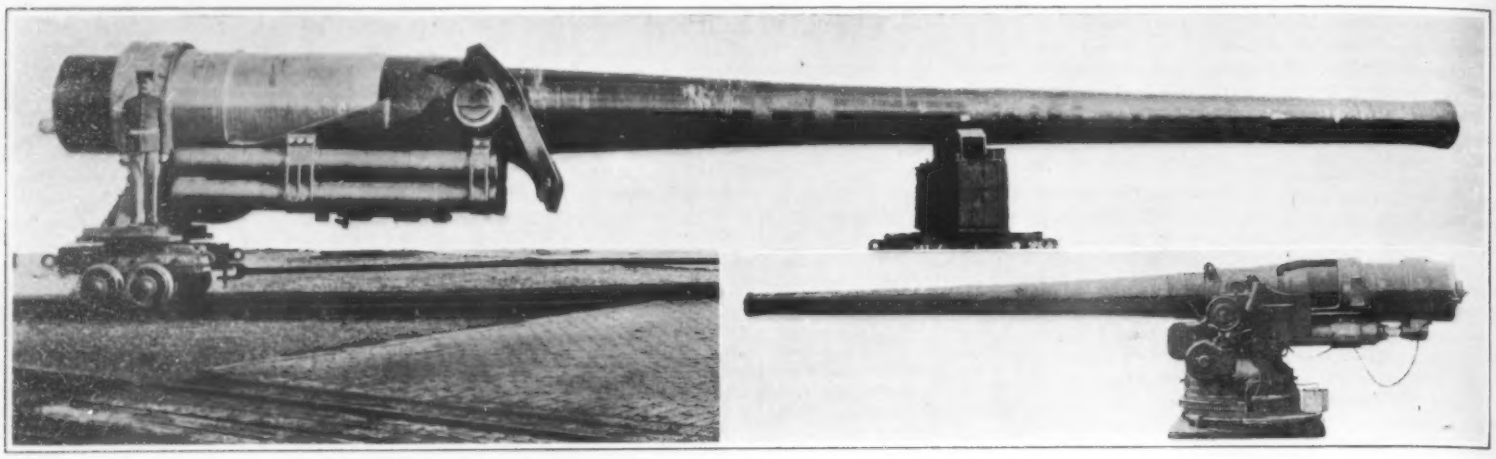
Combination of reciprocating engines and turbines. Turbines with mechanical reduction gear. Turbines with electric motor propulsion.

ENGINE ROOMS OF SAME SIZE AS "DELAWARE'S" (RECIPROCATING) EQUIPPED WITH VARIOUS TYPES OF PROPELLING MACHINERY



Speed of turbine, 1,220 revs. per min. Speed of propellers, 135 revs. per min. Efficiency of reduction gear, 98 per cent.

TURBINE AND MECHANICAL REDUCTION GEAR OF THE U. S. COLLIER "NEPTUNE"



All future battleships will mount the new 14-inch gun for armor attack and the 5-inch gun for torpedo defense.

Recent Development in Ordnance

Demand for Higher Efficiency Met by Our Latest Guns and Armor

By Rear-Admiral N. C. Twining, U. S. N., Chief of the Bureau of Ordnance

PROGRESS in ordnance matters during the past year has been rather in the direction of improvement and development of previously existing types than in the line of marked changes. Naval warfare has not been "revolutionized," nor has any such upheaval been even faintly indicated. The increasing efficiency of the submarine boat, of the torpedo, and of the aeroplane has caused ordnance officials and the navy in general to look ahead to the time when the development of these weapons and methods of attack might demand changes in ordnance or in ship construction to meet them, and tentative plans for such changes have been considered. The aeroplane can not, as yet, be regarded as a material factor in naval warfare; but its possibilities in the future cannot be neglected. The submarine boat and the torpedo have long been elements to be reckoned with, and their usefulness and efficiency are on the increase.

The gun remains the principal offensive weapon afloat and armor the principal element of passive defense. The battle between the two, which has been so often declared lost or won by one or the other, still goes on; though the gun seems to have rather the better of it at the present moment. Already there are rumors of larger and more powerful guns and of armor of greater resisting power. A year ago no modern vessel built or planned carried a gun of caliber greater than thirteen inches, and all of the latest battleships were armed with guns of 12-inch caliber. To-day there are numerous ships building at home and abroad which are designed to carry 13.5-inch and 14-inch guns. Armor's answer to the bigger gun is, so far, increased thickness; but new processes of heat treatment and the introduction of new alloys are rumored, which will restore the former thickness with greater resisting power.

Guns.

The "all-big-gun" battleship of the present day has its prototype in the British "Dreadnought," dating from 1906. Since that date all the principal maritime powers have shown a tendency to confine themselves to battleship design of this type, the main battery consisting of from eight to twelve guns of the largest caliber, mounted in turrets, and the torpedo defense battery of from twelve to twenty or more guns of smaller caliber mounted in broadside.

In the United States Navy the standard heavy gun is at present the 14-inch, 45-caliber gun, while for torpedo defense a 5-inch, 51-caliber gun is used. The following table shows the superiority of these guns over previous types:

Caliber, Inches.	Length in Calibers.	Length in Feet.	Weight in Tons.	Muzzle Velocity, Foot Seconds.	Weight of Shell, Pounds.	Muzzle Energy, Foot Tons.	Extreme Range Ship Mounting, Yds.	Penetration in Krupp Armor, Inches.
5	40	17	3.1	2300	50	1852	7000	2.3 at 6000 yds.
8	51	22	5.0	3150	50	3439	12000	3.0 at 6000 yds.
12	45	46	53.6	2850	870	48084	22000	15.2 at 10000 yds.
12	50	51	56.1	2900	870	51644	24.00	15.6 at 10000 yds.
14	45	54	63.3	2600	1400	65687	21000	15.9 at 10000 yds.

An examination of this table shows that the latest turret guns and torpedo-defense guns are markedly superior to their predecessors. The superiority of the 10-inch gun over the 12-inch, 50-caliber gun is due in part to the greater steadiness of the projectile in flight due to its greater weight. The "hitting power" of the gun is greater than that of its predecessor in spite of the fact that its extreme range as mounted on board ship is less.

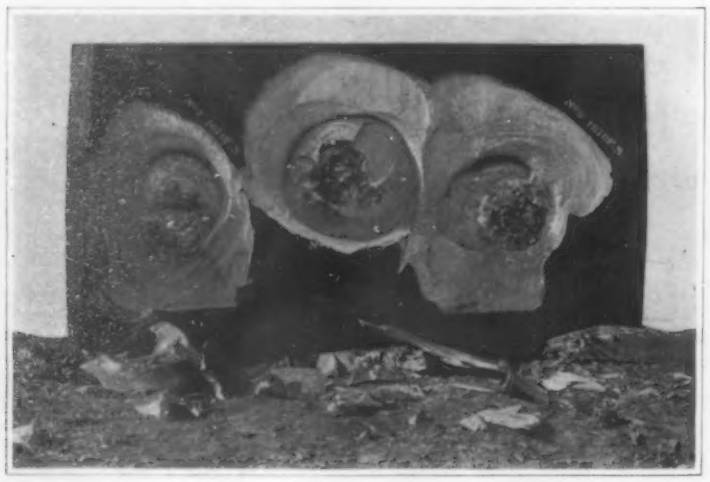
On page 521 are shown the breech and breech-plug of the 14-inch gun, together with an armor piercing shell and powder charge. The shell shown is of the latest "long point" variety, while the powder charge represents the present practice of putting up smokeless powder in silk bags laced on the side to make them rigid. An idea of the length and general size of the 14-inch gun with the slide in which it is mounted in a turret can be gained from the illustration above.

The latest type of gun and mounting for torpedo defense is shown below the 14-inch gun. This gun may be regarded as effective against torpedo boats at its extreme range of 12,000 yards provided the target is visible; at night or in other circumstances rendering the target invisible, the gun is naturally helpless.

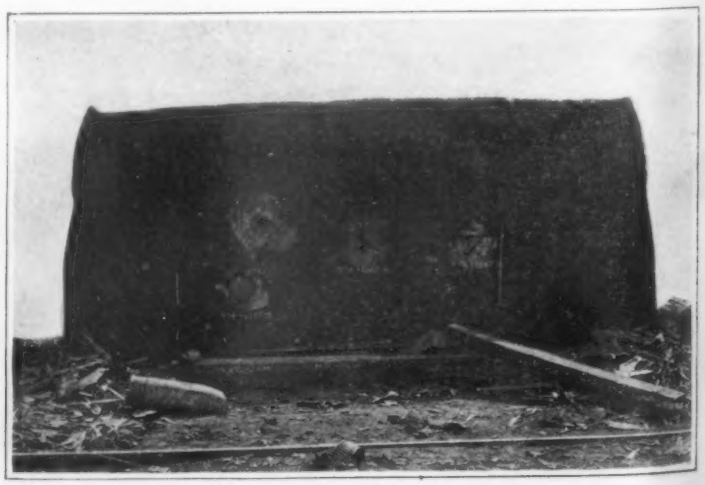
Modern high-powered guns using smokeless powder charges have been proved to have a practically unlimited life under normal conditions of firing; but they erode in the bore very rapidly owing to the high powder pressures they must sustain, and the consequently high temperatures. This erosion is probably due to the action of the powder gases on the metal of the gun as softened by the high temperatures to which it is exposed—about 4,000 deg. F. As the parts of the gun not immediately in contact with the gases suffer no deterioration, the life of the gun may be indefinitely prolonged by renewing the bore. This process is known as "re-lining" and has hitherto consisted in boring out the interior of the gun (to a depth of about one inch in the case of the 12-inch gun) shrinking in a new tube, and then boring and rifling. The facility of re-lining will be enhanced and the cost of the operation will be greatly reduced in the future by building all new guns with conical liners, susceptible of easy removal. The time of re-lining a gun will thus be reduced from seventy-five to twenty-five days.

Gun Mountings.

For a number of years past rumors have been periodically current that this or that foreign country was about to incorporate a three-gun turret in some new battleship. Such advantages as such a system have heretofore presented were mainly in the direction of economy of armor weights, it being readily demonstrable that six guns can be protected with less weight of armor if mounted in two turrets than if mounted in three. There have been, however, countervailing disadvantages in the increased complexity of ammunition supply, turret machinery, concentration of



Krupp plate of 1905, after attack by three armor-piercing shells. No perforation, but excessive flaking of hardened face.



Krupp plate of 1911, after attack by four armor-piercing shells. No perforation and practically no flaking of surface.

SIX YEARS' IMPROVEMENT IN ARMOR PLATE

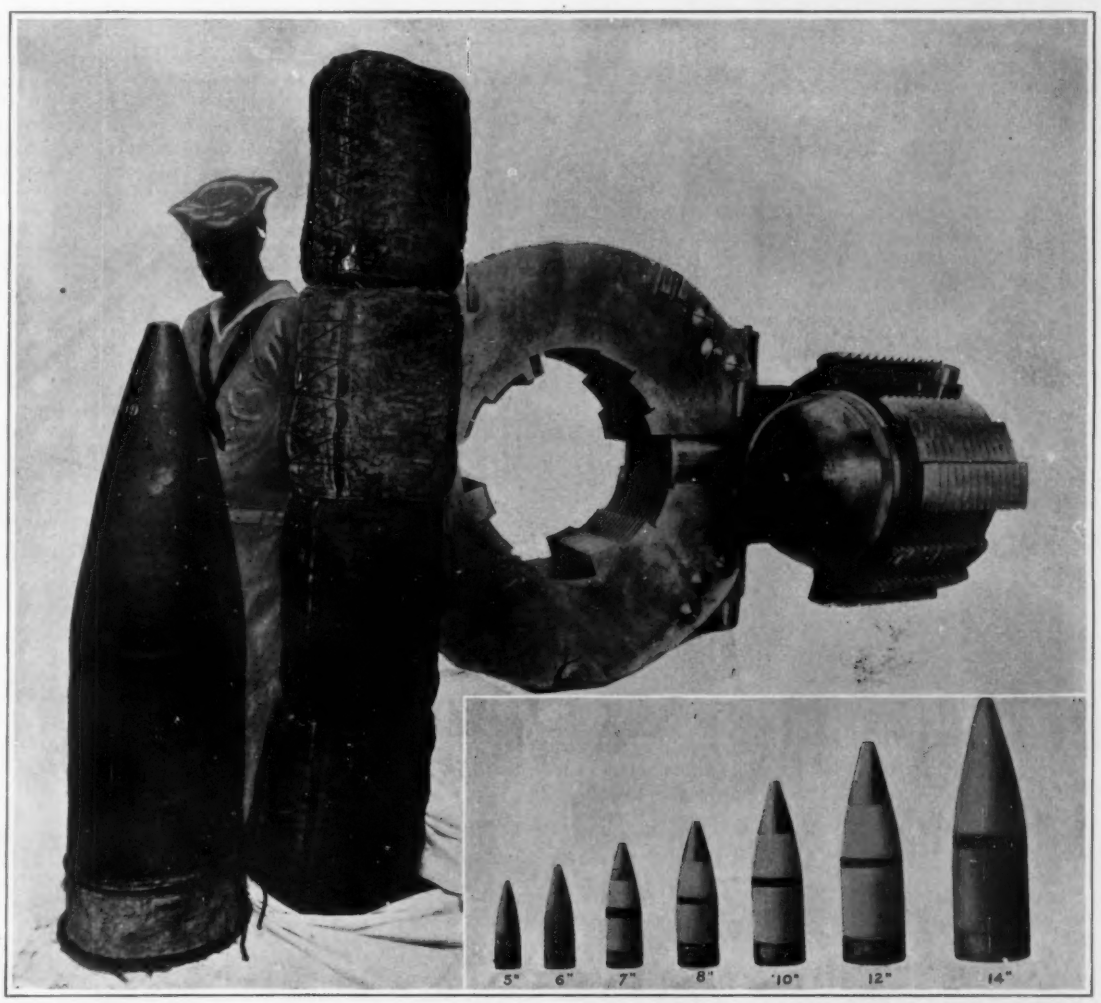
weights, and other features of the system which have rendered its adoption inexpedient. The time seems now to have arrived when the necessities of ship design and tactical considerations have forced the triple turret and it is interesting to note that Russia, Austria, Italy, and the United States have all incorporated it in their latest battleship designs. It is now decided that United States battleships Nos. 36 and 37 will each carry the triple turrets as a part of their main armament. These turrets will embody certain new ideas in gun mountings which have not yet been embodied in any foreign design.

For secondary gun mountings compactness and lightness are essential, but to attain them without sacrificing the rigidity which is necessary for accurate firing requires ingenuity. The mounting for the 5-inch, 51-caliber gun, shown on page 520, is the latest type of this kind of mount which has taken concrete form.

Ammunition.

A nitro-cellulose smokeless powder continues to be the standard propellant for use in our naval guns. It is extremely satisfactory in stability, ballistic characteristics, and keeping qualities. Powder of the same characteristics and composition is used by the army and it may be safely claimed that there is no better smokeless powder in the world. This powder consists essentially of cotton dissolved in nitric acid, then dried, colloided, and pressed into the desired form of grain.

The colloided material is placed in a press, from which it emerges in long strips and rods. These are then cut up into short lengths of the particular size for the powder grain desired. The grains are of different sizes for guns of different calibers, being larger, of course, for the larger calibers. Certain varieties of black and brown powder are still in use for loading shell or for saluting purposes. The prismatic brown powder was the immediate predecessor of smokeless powder.



Relative size of naval shells from 5-inch to 14-inch.

The powder charge, weighing 370 pounds, discharges the 1,400-pound shell with a muzzle velocity of 2,600 feet per second, and a muzzle energy of 65,687 foot-tons. At 10,000 yards the shell will penetrate 15.9 inches of Krupp armor.

SHELL, POWDER, AND BREECH MECHANISM OF THE NEW 14-INCH NAVAL GUN

The navy powder is manufactured in lots of from 25,000 pounds to 100,000 pounds, depending on the caliber of gun for which it is intended. Methods of manufacture have been so perfected that these powders, when not unfavorably affected by climatic and other unfavorable conditions, retain their qualities and are serviceable for from twelve to fifteen years. In case deterioration occurs due to such conditions, ample warning is given by the physical appearance of the powder, so that no spontaneous explosion or combustion is ever to be apprehended; it is, in fact, extremely doubtful whether spontaneous combustion is possible, unless the powder should be subjected to abnormally high temperatures.

Powder which has changed in character to such an extent as to reduce its ballistic value is now re-worked and made over into new powder of the best quality at a small cost. The re-working consists of grinding the grains in water, drying the resulting paste, and then pressing it into rods or ribbons as required; the methods pursued are much the same as those used in original manufacture.

Smokeless powder possesses many points of superiority over black or brown powder; one of the best known is the fact that its combustion produces but little smoke; such as is produced is largely gaseous in nature, containing very little solid matter, and it is, therefore, quickly dissipated. This fact gives to the use of smokeless powder a great tactical advantage for military and naval purposes. A second point of superiority lies in the fact that the combustion of smokeless powder is practically complete, there being an exceedingly small percentage of solid residue remaining; the whole mass of the powder is, therefore, converted into gas, the expansion of which imparts velocity to the projectile.

The particular form of grain in use for all guns of large caliber is what is known as the "multiperforated" form, in which the cylindrical grain is pierced by a number of longitudinal holes. When such a grain is ignited the burning progresses both from and toward the center with the result that the burning surface is practically constant until the grain is entirely consumed. In consequence of this fact the volumes of gas produced in any two units of time while the projectile is in the gun and traveling toward the muzzle are nearly equal, and the maximum pressure on the walls of the gun is not so much greater than the mean pressure as to require that the breech of the gun be made enormously heavy as compared with the chase and muzzle, as was the case with guns designed for use with quick-burning black powder.

The quality of projectiles is being slowly but surely improved. The possible range has been increased by changing the form of the head from the blunt type in general use in recent years, to a long, sharp ogival. The above illustration shows the present type of shell for guns of 5-inch to 14-inch caliber. The point of the shell, in all except the 5-inch, is a separate piece from the remainder of the shell and is made of soft steel; the body of the shell is of very hard and tough forged steel, containing alloys of nickel, chrome, vanadium and other metals. It is in the quality and composition of the steel used, and in the methods of treatment, which give the shell hardness without brittleness, that the principal improvements have been made in recent years. These points are, in the main, manufacturers' secrets, not disclosed even to government officials.

The function of the soft steel cap is to support and guide the hard point of the shell and thus enable it to "bite" and penetrate the armor on impact. The addition of this very simple device to steel shell increases their penetrative efficiency fully 20 per cent. Such caps have been in use for a number of years; it is only their form that has been recently changed.

High-explosive bursting charges are a necessity in modern armor-piercing shell. The walls of these shell must be very thick in order that the shell may withstand the terrific shock of impact on armor and that it may penetrate; the interior cavity is thus too small to contain a sufficient amount of "gun powder," as commonly understood, to disrupt the shell. The use of a more powerful explosive is, therefore, necessary.

As an alternative to the adopted method of attack on armor, i. e., by means of a projectile designed to penetrate and explode inside, the method of attacking with shell exploding on contact has been suggested and has been strongly urged by some persons of undoubted knowledge and attainments. The latter method depends for its efficiency on smashing or displacing the armor by the force of the impact and the intensity of the resulting explosion. Experiments have been made along these lines from time to time, but, while the damage done to an armor plate by the detonation of a quantity of high explosive in contact with it is admittedly great, it has not yet been demonstrated that a charge of any explosive which can be safely fired from a gun can effect as great damage in this way as can be effected by detonating inside a vessel an equivalent charge of explosive which can be so fired. The "Puritan" experiments only confirmed the official opinions previously held on this point.

Torpedoes.

The torpedo continues to be held in great favor as a weapon of under-water attack, and it must be admitted that no navy has at present an adequate system of defense against such attack if efficiently delivered. Torpedo nets as carried by the vessels of some foreign navies are ineffective, since torpedoes have been designed which can cut, penetrate, or displace the nets. The searchlight is ineffective, since a torpedo may be successfully launched at a range beyond its reach. Gunfire is ineffective against an invisible target, and the torpedo boat can launch its weapon while still invisible to the gun. Pickets and scouts are not thoroughly effective, since they may, themselves, be attacked and disabled, or they may be eluded. The practical torpedo of the present day may be effectively used at a range of 8,000 yards; a range of 10,000 yards at 27 knots speed is confidently expected in the near future. The United States Navy now has in course of building two types of torpedo which will, beyond a doubt, fill these conditions and may exceed them. The reliability of the torpedo in the hands of the general service is, unfortunately, still questionable and many failures and wild shots are to be expected. There is, however, nothing mechanically impossible in the conditions of the problem of making torpedoes reliable, and recent advances in this direction justify the hope that in the near future a thoroughly accurate long-range weapon will be produced.

The 'Vesuvius," built for discharging so-called aerial torpedoes, is now employed at the Newport Torpedo Station as a torpedo testing vessel.

(Continued on page 534.)

Rank of the United States Among the Naval Powers

Our Present Standing Threatened by the Lack of Colliers and Other Auxiliaries

By Capt. T. M. Potts, U. S. N., Chief of the Office of Intelligence

THE question has been very often asked of late as to how the United States Navy ranks among the naval powers. Ordinarily, this question is answered by giving a tabulated statement of the effective war tonnage of the various nations and establishing their rank with one another in accordance with the amount of their displacement. This answer is accepted by most laymen as being conclusive; but to naval officers and students of naval affairs it is far from being so. To naval officers two questions naturally arise: What constitutes Naval Strength? How is Naval Strength measured? Therefore, in attempting to fix the rank of the United States Navy with reference to that of other powers, consideration must be given—not only to battleships, but to all the various types of vessels which go to make up an efficient, well balanced fleet—to the Merchant Marine upon which a nation must draw in time of war for certain types of ships, and lastly to personnel, active and in reserve, all of which go to make up a well organized navy and measure its strength.

Fleets are created and maintained for offensive operations, and while often spoken of as the mobile defense of a country, the defense lies in the fleet's ability to assume operations against an enemy's fleet, or against the coast or territory of an enemy.

The table below shows the composition of the fleets of England, France, Germany, the United States, and Japan, and includes vessels which will probably be in commission, or ready for commission on January 1st, 1912.

The launching of the first all-big-gun battleship, the "Dreadnought," in England in 1906, completely revolutionized modern battleship construction—so far as offensive power is concerned. The question of an all-big-gun ship had often been discussed and elaborated upon by other nations, but the English were the first to put these ideas to a practical use. All-big-gun battleships constitute a distinct type, and all ships launched since that year have been spoken of as dreadnoughts. The building of this ship placed the navies of all powers upon an entirely different status from that which they had previously occupied; for the "Dreadnought" completely eclipsed in offensive power all ships previously built. Earlier ships, however, so long as they are employed in the active service of navies, cannot be considered as absolutely obsolete at the present writing, but in a few years, as the number of dreadnoughts increases, they will undoubtedly be relegated to the second line.

Another type of warship, commonly known as the battleship-cruiser, has developed within the last five years and bids fair to be an important factor in all future naval engagements. The first of these ships was launched by England and called the "Invincible," so that the term Invincible is now considered to represent a distinct type of a battleship.

In analyzing the composition of the various fleets of the world, fighting or capital ships, as they are now termed, may be divided into three distinct classes, pre-dreadnoughts, or ships that were built or laid down prior to 1906, dreadnoughts, or all-big-gun-ships, and Invincibles. Battleship-cruisers, with a very high speed, carry a smaller number of heavy guns, of the same caliber as those of modern battleships, and their protection has been somewhat reduced. They must, however, be considered as capital ships.

Total Weight of Metal of Primary Broadside of Capital Ships, January 1st, 1912.

	Weight of Metal of Primary Broadside.			
	No.	Germany.	No.	United States.
		Lbs.		Lbs.
Battleships (Dreadnought type)	7	44,340	6	50,220
Battleships (pre-Dreadnought)	21	62,540	25	132,435
Battleship Cruisers	2	11,900	.....	.....
Armored Cruisers	9	15,130	12	25,500
	.....	133,910	.....	208,155

The table shows that the total warship tonnage of Great Britain is considerably more than double that of any other nation, and, therefore, entitles Great Britain to the position of first in the rank of naval powers. When we come to consider the naval strength of other powers, we find a difference of only about 15,000 tons in the warship tonnage of Germany and the United States, a difference which a layman would probably consider a negligible quantity, or in other words, that these two countries were practically on the same footing. The character of the vessels which make up the fleets of Germany and the United States will, however, be carefully considered by those who wish to determine the exact standing of the two fleets.

The German battleship fleet will, on January 1st, 1912, consist of seven dreadnoughts, twenty-one pre-dreadnoughts and two battleship-cruisers, a total of thirty capital ships, as opposed to thirty-one capital ships in the United States Navy, composed of six dreadnoughts and 25 pre-dreadnoughts, so that numerically, the fleets will be practically equal. When we come, however, to consider the actual fighting value of the units which make up the two fleets we find that, ship for ship, the United States vessels are decidedly superior to those built at a corresponding period in Germany, especially in offensive power.

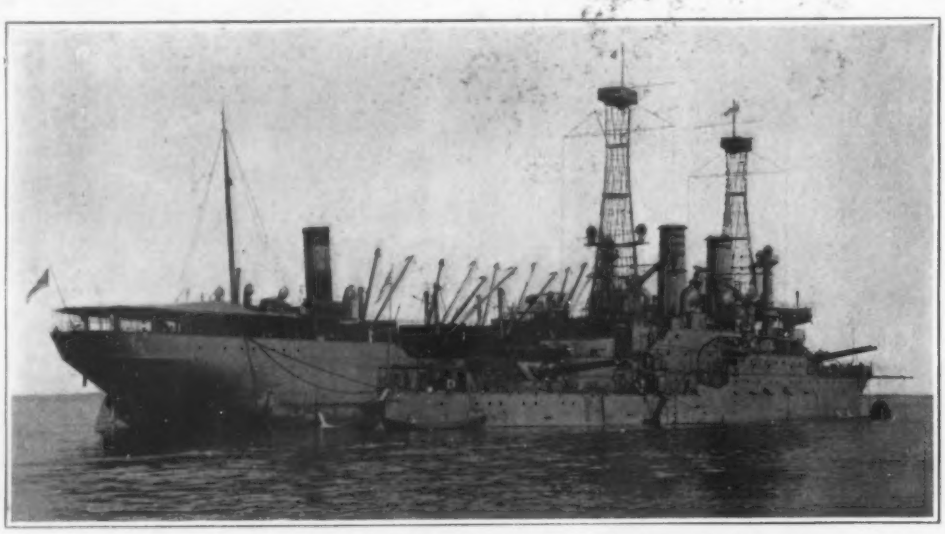
The ten vessels of the "Kaiser" and "Wittelsbach" types carry a main battery of only four 9.4-inch guns, while the ten following vessels of the "Braunschweig" and "Deutschland" types carry only four 11-inch guns in the main battery; as opposed to these, all the battleships of the United States carry main batteries of four 12-inch, or four 13-inch guns, supplemented in all except the six vessels of the "Maine" and "Illinois" types of intermediate batteries of from four to eight 8-inch guns.

France will have only twenty-one pre-dreadnoughts ready for service on the first of January, 1912, while Japan will have but thirteen; although the latter nation will on that date have two of the battleship-cruiser type.

Of the thirteen battleships which comprise the fleet of Japan, the "Fuji" is practically obsolete; five are reconstructed and repaired vessels captured in the late war and two are coast defense vessel type. The batteries of the two vessels of the "Satsuma" class—4-12 inch and 12-10 inch guns—are so powerful, however, that these vessels should properly be considered dreadnoughts, and the two vessels of the "Kawachi" type carry batteries considerably more powerful than other pre-dreadnoughts of the same period of building.

The comparison, therefore, between these four countries as to their battle fleets, is decidedly in favor of the United States, and it may be contended that so far as the strength of the battleship fleet is concerned that the United States is decidedly superior to that of either France, Germany, Japan, or any other nation.

Considering the geographical and political conditions in the United States, students are pretty generally of the opinion that, in the event of future hostilities between this country and any other nation, the United States will have to carry on an offensive warfare; in other words, will be compelled to take the initiative and to carry on warfare far removed



As pointed out in the accompanying article, the weak point in the U. S. Navy is its limited supply of auxiliary ships, the most important of which is the collier.

NAVAL COLLIER COALING THE BATTLESHIP "SOUTH CAROLINA"

Probable Warship Tonnage of the Principal Naval Powers January 1st, 1912.

	Great Britain.		Germany.		United States.		France.		Japan.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Vessels Completed.										
Battleships (Dreadnought type)	11	213,850	7	138,900	6	115,650	.....	.....	.....	.....
Battleships, first-class	46	672,300	21	252,712	25	334,146	21	300,676	13	191,698
Coast defense vessels	.....	.....	5	20,273	4	12,900	2	15,400	2	9,086
Armored cruisers (new type)	5	96,850	2	41,000	.....	.....	.....	.....	2	29,200
Armored cruisers	34	406,800	9	94,245	12	157,445	22	211,070	11	108,900
Cruisers above 6,000 tons	14	146,500	.....	.....	5	43,800	3	24,022	2	13,130
Cruisers 6,000 to 3,000 tons	42	200,460	24	98,180	14	49,541	5	21,250	8	30,303
Cruisers 3,000 to 1,000 tons	23	49,540	15	34,528	10	12,260	2	4,706	5	9,158
Torpedo boat destroyers	205	112,210	107	57,012	36	21,306	72	26,782	59	22,957
Topedo boats	59	12,710	22	3,789	28	4,802	225	21,224	59	5,560
Submarines	74	23,282	14	4,080	26	7,200	66	17,680	10	1,832
Total completed	.....	1,934,502	.....	744,719	..	759,050	.....	642,810	.....	421,834
Vessels Building and Authorized.										
Battleships (Dreadnought type)	11	263,500	9	216,500	6	162,000	4	92,400	2	41,600
Battleships	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Coast Defense vessels	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Armored cruisers (new type)	5	116,650	3	73,000	.....	.....	.....	.....	2	55,000
Armored cruisers	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cruisers above 6,000 tons	.....	.....	..	.....	.....	.....	.....	.....	.....	.....
Cruisers 6,000 to 3,000 tons	10	52,360	6	33,750	.....	.....	.....	.....	3	15,000
Cruisers 3,000 to 1,000 tons	.....	.....	.....	.....	1	1,500	.....	.....	.....	.....
Torpedo boat destroyers	23	18,400	12	9,600	14	12,450	19	13,700	3	2,550
Torpedo boats	.....	.....	.....	.....	.....	.....	2	360	.....	.....
Submarines	14	11,500	12	6,000	13	7,150	18	10,500	3	1,260
Total building and authorized	.....	462,410	.....	337,850	.....	183,100	.....	116,960	.....	115,410
Total completed, building, and authorized	.....	2,396,912	.....	1,082,569	.....	942,150	.....	759,770	.....	537,244

from our coasts or naval bases. This leads up to a consideration of the number and character of the vessels which make up an efficient, well balanced fleet for offensive operations, such as torpedo destroyers, scouts, repair ships, fuel ships, ammunition ships, hospital ships, transports, supply ships and mine-laying vessels—all of which are essential adjuncts of a fleet.

Torpedo Destroyers.

It is considered by students of naval operations that at least four torpedo destroyers are necessary for the defense of each battleship.

The rapid development of the automobile torpedo and its increased range render it practically impossible to defend a fleet by means of illumination or the use of searchlights, as the torpedo has now reached a range beyond which, even under the most favorable conditions, the searchlight is of doubtful value. We must, therefore, depend, for the protection of our battleship fleet, if operating upon an enemy's coast or in proximity to its battleship fleet, upon torpedo destroyers, scouts and other outlying vessels, thrown out as a shield for the protection of the battleships.

An examination of the table shows that on January first, 1912, England will have two hundred and five torpedo destroyers, Germany one hundred and seven, France seventy-two, Japan fifty-nine, while the United States will possess but thirty-six. This shows that the United States is woefully deficient in torpedo destroyers, as the estimated number for the protection of a fleet composed of sixteen vessels is sixty-four, and therefore, so far as this element of strength is concerned, the United States ranks below Great Britain, Germany, France and Japan.

Scouts.

The scout is the eye of the fleet, and no matter whether our fleet is operating on the defensive along our own coasts or on the offensive on an enemy's coast, information as to the movement of the enemy is a most important factor in conducting naval operations. The scout is in no sense of the word a fighting vessel, and its principal characteristics should be speed; ability to steam at high speed in all weathers and ability to keep the sea for long periods without replenishing its fuel supply.

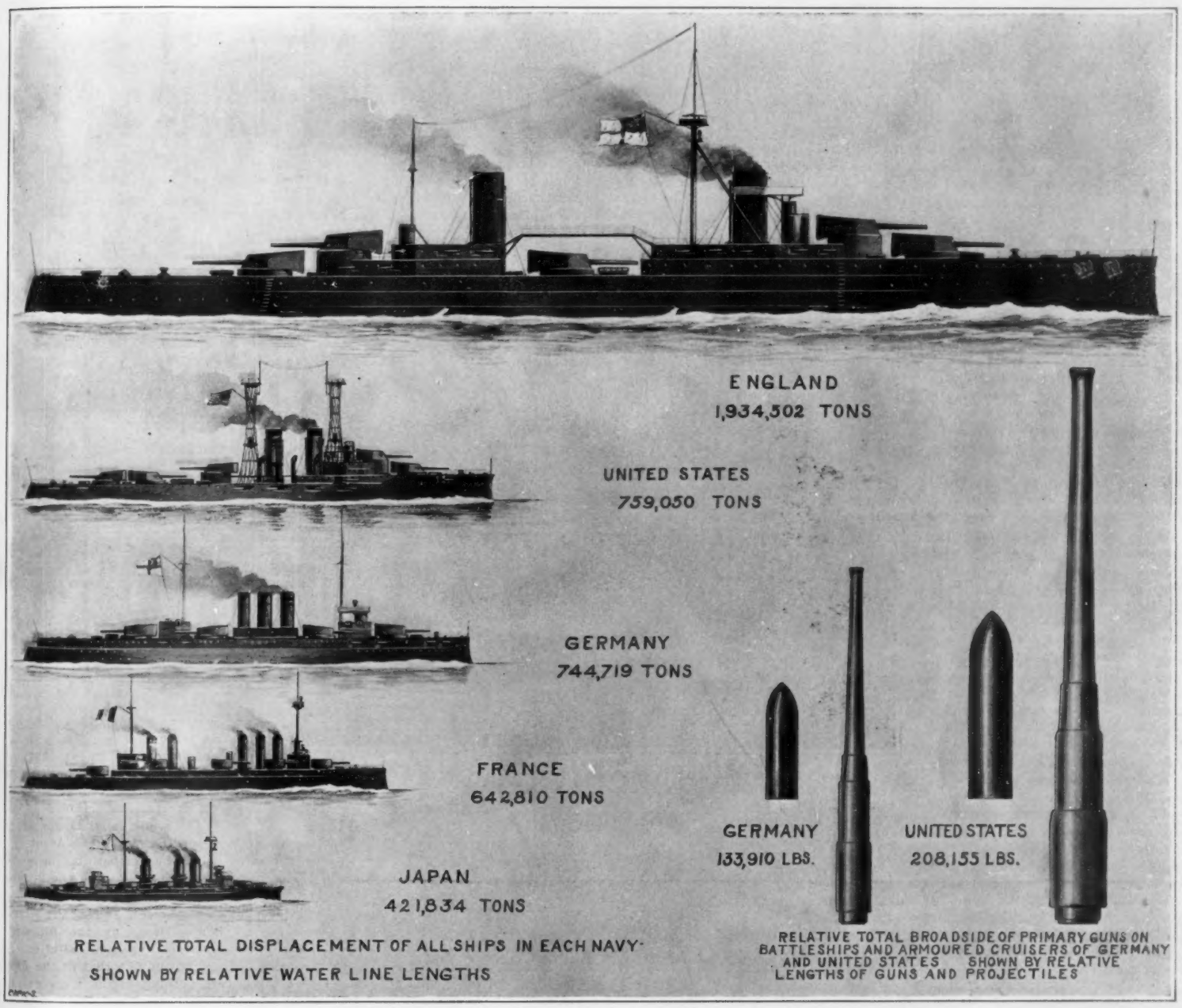
While the introduction of wireless outfits on board modern ships is of the greatest possible value, interference with the successful transmission of a message from a scout to the main body of the fleet is not difficult of accomplishment, and in order to convey important information to the Commander-in-Chief of a fleet, it may be necessary for the vessel obtaining such information to communicate with the fleet by visual signals. While the scout also forms part of the outposts of a fleet for its defense against surprise and against torpedo attack, its principal function is discovering the whereabouts of the enemy's fleet, keeping in touch with and successfully transmitting information as to its movements—to its own fleet.

The United States Navy possesses but three vessels of this important type, and furthermore, its Merchant Marine does not furnish a single vessel which is in all respects adapted for scouting purposes. Few, if any, of our merchant vessels are capable of reaching a speed of more than twenty-one knots, and when it is considered that the modern scout has a speed of at least twenty-six knots, it is clearly seen how inadequate our merchant ships are for scouting purposes. As against the three vessels of this special type, England possesses twenty-three, with nine building, Germany ten, with six building, and Japan four, with three building; therefore, so far as this type of vessel is concerned, the United States Navy is decidedly inferior to those of England, Germany and Japan. On the other hand, these three countries possesses in their Merchant Marine a large number of vessels, which in a very short time can be converted into efficient scouts.

Fuel and Ammunition.

One of the most important things to be considered in the operations of an offensive fleet is the problem of supplying fuel and ammunition. Battleships whose fuel or ammunition supply has been reduced or exhausted cannot be considered very formidable. Arrangements must be made for the furnishing of fuel to our battleships at stated intervals, either through colliers built for this purpose by the Government or else through vessels bought or chartered for the purpose. The United States Navy possesses to-day twenty colliers fit for service, but a large percentage of these vessels has such a small cargo-carrying capacity as to be of little value to the fleet. England, Germany and Japan possess few, if any, regular naval colliers, but each of these countries possess a very large Merchant Marine, from which colliers, supply vessels and other auxiliaries will be drawn in the event of hostilities. We possess no such marine, and to-day there are but very few vessels flying the American flag which are at all suitable for naval purposes in any character. Unless, therefore, something is done to

(Continued on page 532.)



The greater gun power of the U. S. Navy as compared with that of Germany is due to our pre-dreadnought ships carrying heavier guns in the main batteries. Future sea-fights will be fought with dreadnoughts. At the present rate of construction, Germany, in 1917, will possess twice as many dreadnoughts as the United States.

GRAPHIC COMPARISON OF THE RELATIVE STRENGTH OF THE WORLD'S NAVIES

On Board a Battleship

Intimate View of the Life of a Community of One Thousand Souls

By Captain Albert Gleaves, Commanding U. S. Battleship "North Dakota"

LIFE on board ship is but little understood by the general, and the ways of the service, if not past finding out, are a closed book to the majority of our fellow citizens. A more intimate contact between the people of the service and commercial people would benefit both, with the result that there would be less apprehension for the pocket-book when battleships are proposed, and less talk of the Angel of Peace hanging his head at the sight of a Building Program. On the contrary, if the Navy and the people knew each other better, the "sober citizen" would realize from personal knowledge that he is paying only a trifling insurance on his property for a very real and substantial protection, and the Angel of Peace, instead of protesting, would preen his wings for higher flights and chant the ringing notes of an *Io triumphe* as he soared.

Although the Atlantic fleet of twenty to twenty-five capital ships, and its accompanying auxiliaries, such as colliers, supply and store ships, and repair ships, represent an enormous outlay of public funds, the sum is insignificant when compared with the almost fabulous wealth that it protects, and the security that it affords. Some one who has a genius for statistics estimates the money value of every enlisted man as $5,000, and places the value of the fleet at 300 millions. If a committee of citizens from all parts of the country could visit the fleet on the Southern Drill Grounds, when the ships are cleared for action and just as prepared to engage an enemy as they are to shoot up an irresponsive and insensate target, it would require no argument to prove the need of a navy, nor many arguments to demonstrate the absolute necessity of definite expansion in order to maintain a *sufficient* one. That task, however, is for others. The object of this article is to give some idea to the layman of the *vie intime* on board a battleship in the fleet, how the men live and what they do.

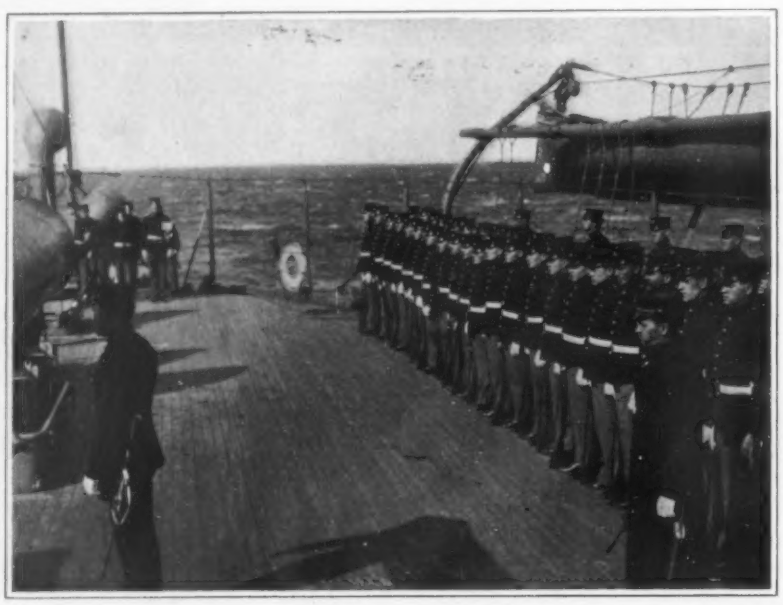
Due to perspective the first view of a battleship may be disappointing. She will probably not appear as big as she has been described; but, once on board, this delusion vanishes. She is a master piece of man's cunning and ingenuity that excites enthusiasm; but she must be studied much and long before she is fully comprehended. Viewed from the taffrail, looking forward and upward, there is nothing more impressive of the majesty and power of a ship. The eye catches, in one glance, the armored turrets, the searchlight towers, the broad-bellied funnels, the ponderous cranes, and towering above all, those prodigies of naval construction the lattice masts—the very latest thing in battleships—called by our sailors "haystacks," and by the English "scrap-baskets."

Each turret with its pair of 12-inch guns weighs about seven hundred tons, but in spite of the inertia of this mass, it is so nicely balanced that the guns can be laid to a hair's breadth on the target, and with no more physical effort than is required to turn a wheel or move a lever. The guns fire a shell of 870 pounds with a powder charge of 340, and thy can be loaded, aimed and fired every thirty seconds, and with such marvelous accuracy and precision, that at a range of five miles, they can make twenty per cent of hits on the target, which at that distance appears in the telescope of the gun no bigger than an open umbrella.

A battleship comprises a community of approximately one thousand souls, in which a centralized and autocratic government prevails. The division of labor, exercises and drills, the rules that govern the hours of eating, sleeping and recreation, are the last words in routine and organization. Every man has his place and number, and there is not an article on board, from a torpedo to a water breaker, that has not its allotted space. Order and system are paramount, and the very atmosphere breathes of discipline. At no time is this so apparent as in an emergency; at every signal of danger, whether it be of fire, collision or man overboard, every man instantly jumps to his station, with a perfect knowledge of what is expected of him; but until he gets there, he doesn't know whether it is the real thing or a drill.

The head of this community of sea-people is, of course, the captain. In battle his station is in the conning tower, and under his hand are all the latent Titanic forces of powder, gun-cotton and steam, which may be released only at his bidding. In matters of administration he is judge and jury, and daily at the mast the delinquents are brought before him; he listens to the evidence, and there is no law's delay in his judgments. He messes alone, and his life for the most part is a solitary one. A wise captain will not burden himself unnecessarily; if he would be happy, he must apply to his duties what the Romans used to say of the Praetor, *de minimis non curat*, leaving to others "the mere rude explicit details."

The wardroom mess is presided over by the commander or executive officer, and is composed of the staff officers and the lieutenants. And merry times they have when the rigid discipline of the day's work gives place to post-prandial relaxation of the evening. Then there are the junior officers' mess composed of midshipmen, and also the mess composed of warrant officers, those men of the rank and file who by faithful service have become gunners, boatswains and machinists. Cheeks and Chips as described by Marrayat are as dead as Henry IV. The old stories of the wind jammers have passed into oblivion, and the service to-day is unconsciously working out new traditions that will be handed down to the coming generation of sea folk.



Of this most effective corps, each battleship carries two officers and sixty to seventy men.

THE MARINES

Forward of the mast there is a big household, which requires $75,000 per month to care for, clothe and feed in their ten-million-dollar home. Nearly all trades are represented in this little kingdom of the sea: Tailors, shoemakers, photographers, jewelers, barbers, and musicians; for the most part a man is allowed to ply his trade so long as there is no interference with his military duties. Regular prices are established by the captain, and as there is no competition, each has a large *clientele*. The galleys have the best possible system of cooking, supplemented with electric potato peelers, electric meat choppers and electric dish washers. The bakery provides bread at all times instead of hard-tack, which was formerly supplied, and furnishes seven hundred loaves daily; there is a laundry, which has a fine equipment of machines run by electricity, and is handled by sailors who are excused from all other work except battle and fire stations; a cold storage with a capacity for provisions for one month for the entire ship's company, and a hospital or sick-bay, well lighted and well ventilated, which is located in a comfortable part of the ship. The hospital contains a sick ward proper with bunks for a score of patients, the isolation ward and the operating room. The last is fitted with every convenience known to modern practice, including an adjustable operating table and a sterilizing plant. Every battleship has a branch post-office in charge of sailors appointed by the captain, which is under the same postal regulations that govern the shore stations. A complete telephone system connects all parts of the ship, and is supplemented by voice pipe communication, which is used principally in action. There is also a wireless installation, and officers as well as the operators are encouraged to become proficient in its use.

Those who are concerned especially for the moral welfare of the men will be interested in the "brig" as sailors call the prison, and they will perhaps be surprised at the spacious, not to say comfortable *pointe d'arret* of those who violate the Articles for the Better Government of the Navy. Down below the gun deck are the berth deck spaces, and still farther below are innumerable storerooms, the magazines and torpedo room, ammunition passages and dynamo rooms.

The pay of the men varies from twenty to one hundred and fifteen dollars per month, depending upon the rate, length of service and conduct. Those who wish to save their money may deposit it in the bank with the paymaster, and the government pays four per cent interest. As the term of enlistment is for four years, it is not difficult for a man to save as much as fifty or sixty per cent of his pay during his cruise.

On Sundays after inspection, the bugler sounds the church call, and the church pennant, a blue cross on a white triangle, is hoisted *above* the national colors. Attendance at church is of course not compulsory, but in the words of the Articles of War, "it is earnestly recommended to all officers, seamen and others in the naval service diligently to attend at every performance of the worship of Almighty God." The altar is rigged below decks, and apprentices selected from the Catholic lads act as acolytes, the priest in his vestments conducts the services with all the rites of bell, book and candle, as if on shore. A large percentage of the crew are usually Roman Catholics, and so the temporary church is always crowded.

Of course the whole idea of a ship and its reason for being is to fight, and until a captain can feel that his ship is ready at all times for battle, his task remains incomplete. The nearest approach to action at present is the semi-annual target practice, and the rivalries of the Derby and the Ascot are as nothing compared with the competition between ships for the coveted gunnery pennant and the bronze trophy, that Ark of the Covenant which is the final *cachet* of efficiency and achievement. During the period of preparation immediately preceding the practice, when "days are full of labor and nights devoid of ease," and everybody is under a strain like that of the first public speech, one hears nothing in the mess rooms and about the decks but discussion and arguments relating to "hits per gun per minute," this or that system of fire-control, and the latest suggestions for "plotting and tracking." The ships lose their smart appearance, for there is no time for the paint brush and the holy-stone; men and officers are rarely out of dungarees; they live in the turrets, working day and night to perfect the adjustment of every detail of the mechanism for loading, training and firing. When the day arrives for which the months before have been a training, the ship is cleared for action, and stripped of all superfluous articles until she looks as sleek as a race horse clean groomed from the paddock. The scheme, generally speaking, is this: The ship steams to the firing line far away from the target, then rounds to, and makes the "approach" at full speed. When she comes within range, fire is opened at the target, which looks like a blur in the haze. If a division of four ships are engaging a string of targets towed in tandem, it is a sight never to be forgotten. Broadside follows broadside with astonishing rapidity; the thunder of the guns is deafening and would be absolutely destructive to the ear drums, were it not for ear protectors. The people in the turrets and in the conning tower experience no inconvenience from

this cause, but out on the deck in the open, the shock is tremendous, so much so that a broadside of ten guns heels a 20,000-ton ship four degrees. When the firing begins, hot blasts from the guns flick the air, a flame-slitted reddish brown smoke spurts in thick clouds from their "rude throats," but dissipates almost instantly, and the air is filled with the pungent odors of burnt gases. The spotters aloft watch anxiously for the geyser-like splashes, that show where the shot struck, and the sight-bar ranges are quickly changed until the gun-pointers are "on."

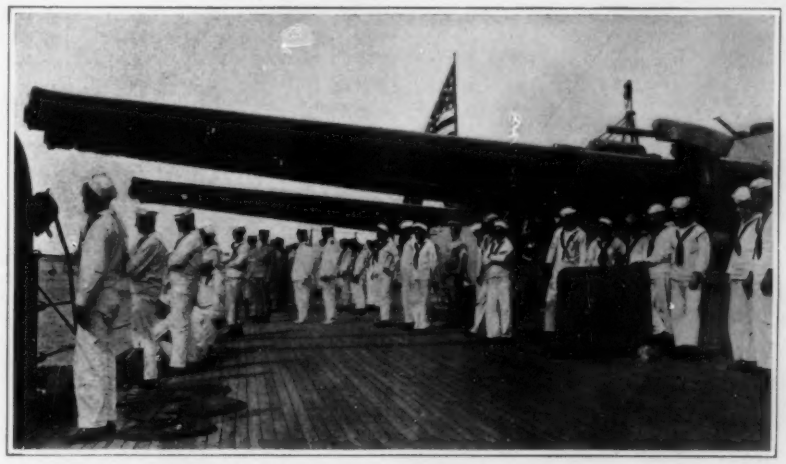
There are other drills and many of them; abandon ship, fire, and collision, signals and boats, and in addition there is the never-ending work of the care and upkeep of the ship, which must go on constantly.

But besides being sailormen by profession, the bluejackets are given something more than an elementary instruction in soldiering; they drill as companies, regiments and brigades; they make practice marches, and when occasion offers they go into camp as at Guantanamo.

But it is not all work on board ships; there is some beer and skittles. The routine keeps every one busy pretty much all the time; still there are intervals between drills, and on certain afternoons, when there are no drills at all and the men may smoke and mend their clothes, or get down to their ditty boxes, and spend an hour or so with old letters and photographs. Smokers are a feature of life on board, and there is nothing like the quarter deck of a battleship for the *mise en scene* of a wrestling bout, a boxing match, a song and dance, juggling, slack wire performance, or any other stunts for which there is ample talent in a crew of one thousand men. Then the tops of the turrets are crowded with the bleachers, and officers and crew gather together around the improvised ring. Usually the athletic officer or the chaplain is the master of the revels. It is astonishing how much genuine talent is found in a ship's company, and the artists are always ready to contribute to the entertainment of their shipmates.

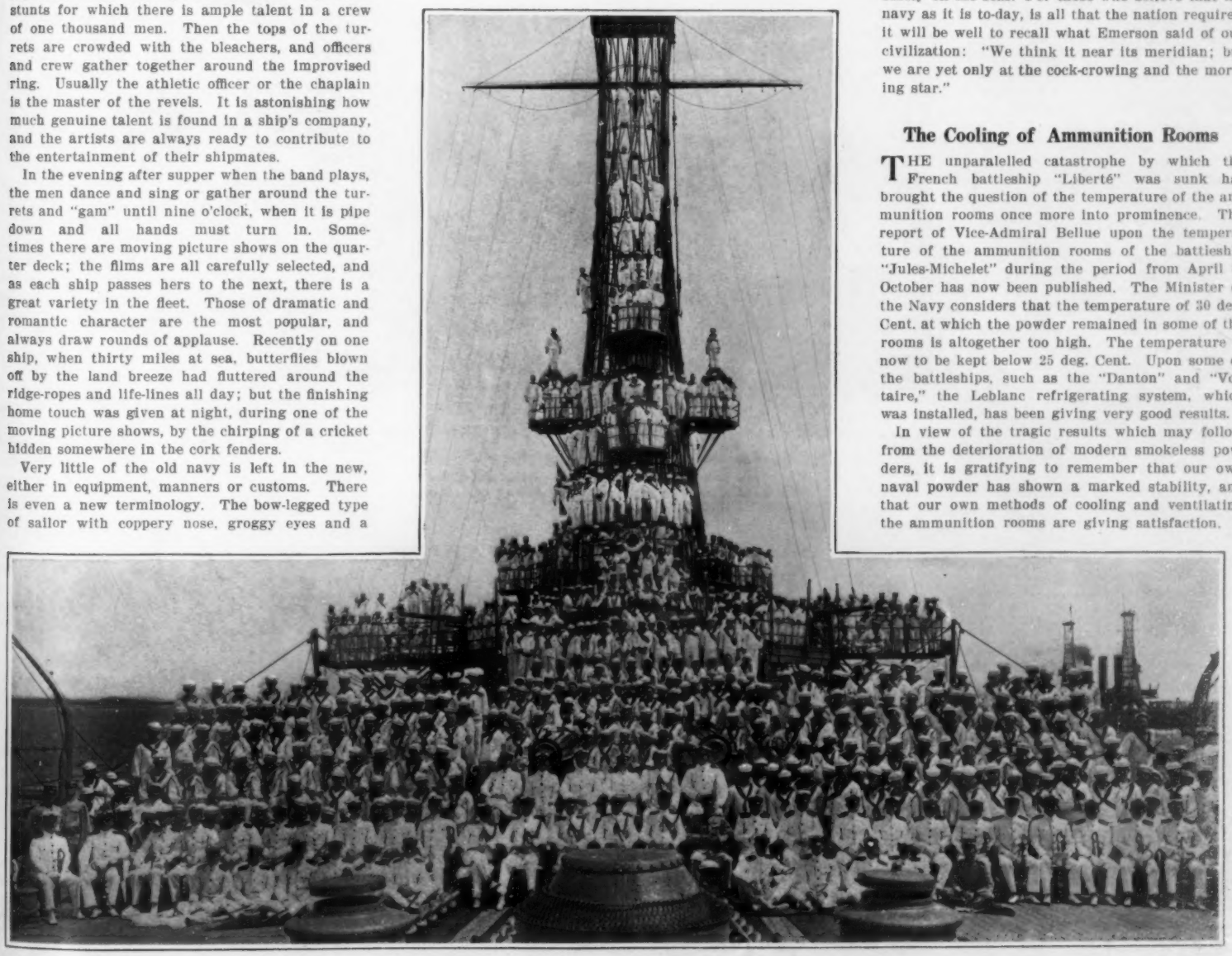
In the evening after supper when the band plays, the men dance and sing or gather around the turrets and "gam" until nine o'clock, when it is pipe down and all hands must turn in. Sometimes there are moving picture shows on the quarter deck; the films are all carefully selected, and as each ship passes hers to the next, there is a great variety in the fleet. Those of dramatic and romantic character are the most popular, and always draw rounds of applause. Recently on one ship, when thirty miles at sea, butterflies blown off by the land breeze had fluttered around the ridge-ropes and life-lines all day; but the finishing home touch was given at night, during one of the moving picture shows, by the chirping of a cricket hidden somewhere in the cork fenders.

Very little of the old navy is left in the new, either in equipment, manners or customs. There is even a new terminology. The bow-legged type of sailor with coppery nose, groggy eyes and a collar of whiskers around his face, survives only in the penny-dreadfuls and comic operas. He has given place to bright-eyed lads, lean in the flank, well groomed, quick and ready to meet any emergency. It is worth noting that the average age of the ship's company is less than 25 years. The man-of-war's man of to-day is a self-respecting, intelligent citizen (only about four per cent are aliens) who reflects credit on the flag wherever he may go. In the cruise of the Atlantic fleet to Europe last winter, 12,000 men visited London and Paris, and there were only a few instances of serious misconduct, and although leave was granted to visit Norway, Sweden, Germany and Ireland, there was no instance where they did not return to their ships, and for the most part on time. The appearance of our men drew forth from an English writer a sneering article commenting on their lankness, lack of physique, and, tell it not in Gath, in some special cases, their kid gloves and eye glasses. A French artist in Paris was not more complimentary in his cartoons. However, it is good to see ourselves as others see us, and as we are not responsible for foreign spectacles we may afford to be amused. There is another point. The Honorable Herbert Satterlee recently referred to the United States Navy as the Great American University. The comparison is apt and just. It is a university whose students number 48,000 youths and men from all parts of the country. This ocean university costs the Government 130 millions annually, but in it is taught that which above all things is the corner stone of every great nation, respect and obedience to constituted authority. The hundreds of sailors who yearly leave the navy with honorable discharges, and go out in every-day life become—it may be unconsciously—missionaries for the service. They return to their people with the story of those who "live between sea and cloud," who pursue their occasions on the sea in craft as different from the ships of yesterday as the ark differed from the Navy of Tarshish. In time their knowledge of the service will spread, and gradually the people will come to have as much pride in their navy as the British people have in theirs; and when that time comes there will be no fear or apprehension as to our future security on the seas. For those who believe that the navy as it is to-day, is all that the nation requires, it will be well to recall what Emerson said of our civilization: "We think it near its meridian; but we are yet only at the cock-crowing and the morning star."



The complement of our latest battleships is one thousand officers and men of whom the greater part are seamen.

THE SEAMEN



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This remarkable photograph, taken from the bow of the "Connecticut," shows only one-third of the total complement of 980 officers and men. Admiral Osterhaus, commander-in-chief of the Atlantic fleet, is the central figure in the second line.

ON THE FO'CAS'LE DECK OF THE U. S. FLAGSHIP "CONNECTICUT"

The Cooling of Ammunition Rooms

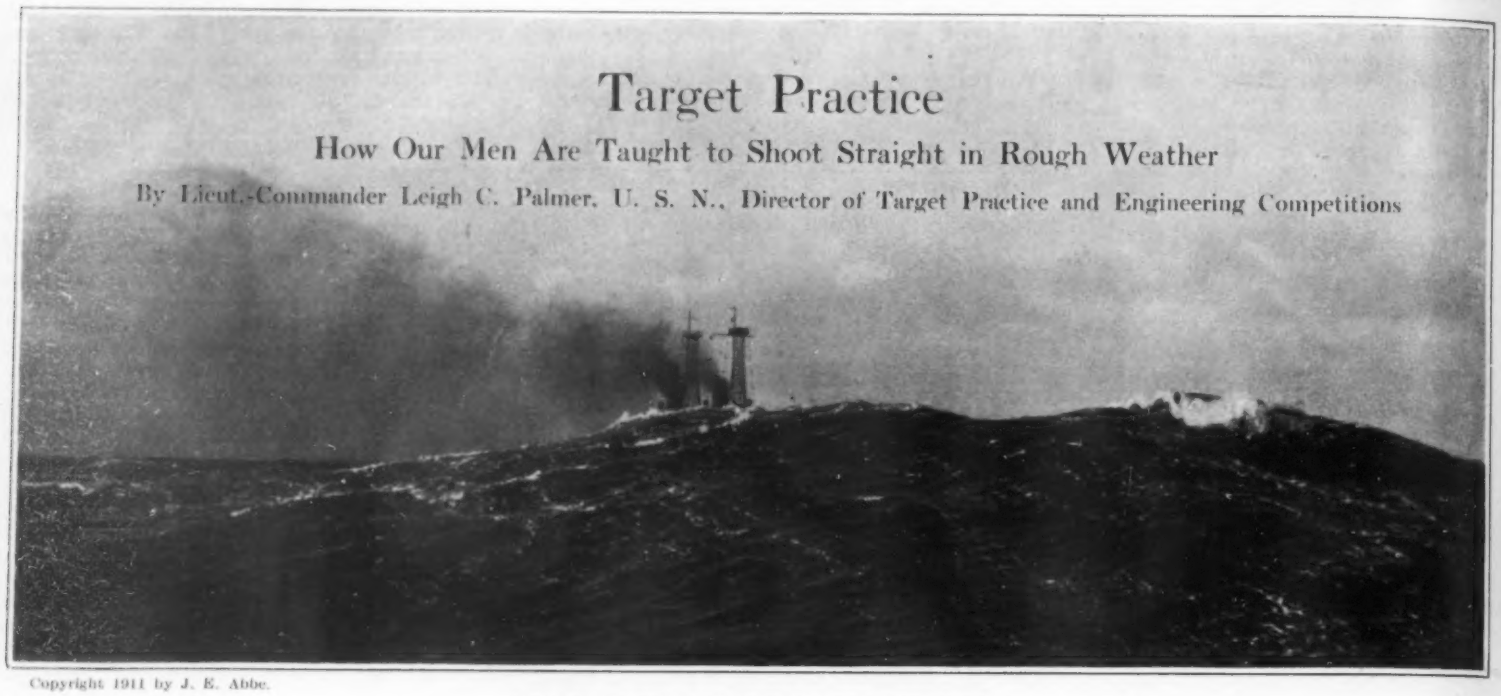
THE unparalelled catastrophe by which the French battleship "Liberté" was sunk has brought the question of the temperature of the ammunition rooms once more into prominence. The report of Vice-Admiral Bellue upon the temperature of the ammunition rooms of the battleship "Jules-Michelet" during the period from April to October has now been published. The Minister of the Navy considers that the temperature of 30 deg. Cent. at which the powder remained in some of the rooms is altogether too high. The temperature is now to be kept below 25 deg. Cent. Upon some of the battleships, such as the "Danton" and "Voltaire," the Leblanc refrigerating system, which was installed, has been giving very good results.

In view of the tragic results which may follow from the deterioration of modern smokeless powders, it is gratifying to remember that our own naval powder has shown a marked stability, and that our own methods of cooling and ventilating the ammunition rooms are giving satisfaction.

Target Practice

How Our Men Are Taught to Shoot Straight in Rough Weather

By Lieut.-Commander Leigh C. Palmer, U. S. N., Director of Target Practice and Engineering Competitions



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HEAVY WEATHER IN THE NORTH ATLANTIC

A SAILOR'S preparation for battle begins the moment he comes aboard ship. Within half an hour of his arrival, he has been given a station at a gun, with some of the older sailors to instruct him in his duties. The new recruit is first tried at aiming drill with a rifle, to see if there are any personal errors that are likely to disqualify him from the start. If he passes this preliminary step, he is taken immediately to the mechanical instruments, "dotter" and "Morris tube," and is directed to aim at a stationary target. An officer supervises this exercise, and after two or three days' work at a stationary target, the recruit is exercised at a moving target so as to develop his skill in controlling the electrical elevating and training gear in any kind of a seaway that may be encountered in "action." He actually operates the elevating and training gear of the gun he will handle in battle, so that his education is practical from the start.

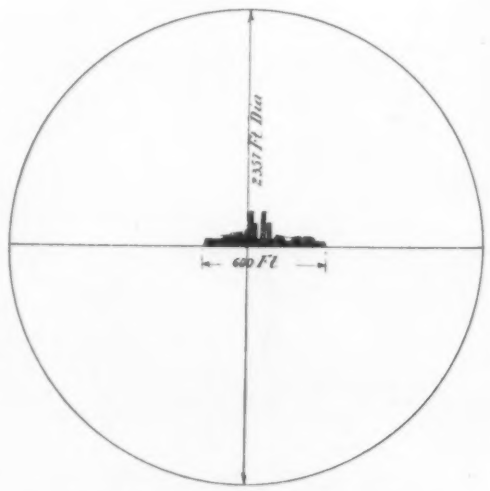
It is easy enough to develop gun pointers to fire from a stationary platform, or to fire in smooth water from a ship under way. As soon as the elements of roll and pitch are brought in, however, an entirely different kind of training is necessary, and it is found that a man who is expert in smooth water may be of no use whatever when firing from a platform, whose motion is as irregular as that of a ship in a moderate sea.

In order that no time may be lost by training gun pointers under smooth water conditions, the motion of the mechanical "dotter" is made to simulate, as nearly as possible, the motion of the ship in a seaway, so that the man may not be deprived of this training, should the ship be alongside the dock or in a navy yard for urgent repairs.

The "dotter" is an electrically controlled instrument, so constructed that the target, a miniature ship, will have the same motion with reference to the pointer's eye as an enemy's ship would have if viewed from one of our vessels steaming at high speed in a heavy sea. When the cross wires of the pointer's telescope are exactly on the center of the target, the gun-firing key should be pressed, causing an electrically operated pencil to make a dot on the target sheet. The target being in motion both vertically and horizontally, the pointer's skill is gaged by the rapidity and accuracy with which he places his "dots" when aiming at the center of the target. The "Morris tube" is a somewhat similar instrument, with the exception that a small rifle attached to the heavy gun is fired electrically and sends its bullet through the target sheet.

The Navy Department has issued a general order that gun-pointers shall be trained throughout the year several times each week, so that, no matter on what duty engaged or in what country the ship may be, guns' crews will be in such efficient condition that they can engage in action at a moment's notice. This order has had a very far-reaching effect; for it keeps the whole personnel and material of the ships up to the highest standard of efficiency at all times.

When the gun-pointers have been trained so that they can follow a rapidly-moving target and make hits with great skill, they are taught to fire on signal, so that whole broadsides may be fired at the same instant. This requires unusual concentration on their part and a most intimate knowledge of the electrical gear by which the guns are controlled. The pointers are required to fire within a second after the firing signal is given; and when it is remembered that they operate the controlling levers of the enormous 60-ton guns and of the turrets of 500 tons weight each, making them follow the peculiar and mystifying roll and pitch of the ship, it can well be seen that constant training and wonderful skill are necessary.



Appearance of battleship at 10,000 yards, as seen through gun-sight telescope.

This crew in No. 3 turret made the highest score on Southern Drill Grounds in the spring battle practice in 1911.

PRIZE WINNING CREW OF U. S. S. "MICHIGAN"

During all the above mentioned training the other members of the guns' crews, the sight-setters who mark the range given by the fire control officers, the men who open the breech-plugs, the men who put in the powder, and the men who hoist and ram home the projectiles are all being daily and competitively trained.

It is this feature of competition that has had most to do with the remarkable development of gunnery in the Navy; for every officer and man is in competition with every other, and at the completion of the target practice or at the end of the year's gunnery work, they receive their rewards in trophies, letters of commendation, and gunnery "E's," which last may be worn only by men of winning gun or turret crews as a special mark of efficiency.

No detail of the training is too small to be given the undivided attention of the officer in charge. The apparently simple motion of setting the sights for each new range has to be watched from day to day, by giving numerous sets of ranges to several men in competition, and noting the rapidity and accuracy with which each accomplishes the work assigned him.

The men who open the heavy breech-plugs, one-half ton in weight, do so wholly by hand-power, as it is found to be as rapid and more reliable than any mechanical means. Even in this particular work the men are placed in competition; for the officer stands by with his stopwatch and starts two plugmen at the same instant withdrawing their plugs, noting the time when each has completed his work. With skilled plugmen this varies from 2 2/5 seconds to 3 seconds for 12-inch guns, and the slower plugmen are given other work requiring less speed and strength.

Every step of the drill is carefully worked out before any two steps are combined. All the men are tried out to see which ones will make the best powder passers, and as this is very trying work during a protracted engagement, only the strongest and most active men are selected for this duty.

The men who ram home the enormous projectiles, weighing 870 pounds, require a great deal of drill, for a slight error of a fifth of a second in applying the necessary force to seat them may well cause

the loss of 3 or 4 seconds in the complete load. As it is necessary to deliver the greatest number of hits in the shortest possible time after the enemy is sighted, it will be seen how vital it is that not a fraction of a second should be lost in any of the details of loading or firing. It may well happen in a naval duel between two battleships that one of them will be put out of action within five minutes after the first shot is fired.

Although to the casual observer of the daily competitive drills there appears only the keen sportsman's instinct to win, there is also a grim feeling that some day the national honor may depend upon the saving of a few seconds, enabling us to deliver a broadside of highly destructive projectiles into the vital parts of an enemy at a critical moment.

The character of the enlisted force of the service has changed remarkably in the last 15 years. There is a community of interest between the officers and men. The reasons for every order are fully explained, so that the men are thoroughly familiar with the object sought and with the material used. This applies not only to loading and firing the guns but to the whole fire-control and range-finding system, so that when a naval battle is fought, intelligent petty officers may take the place of officers who are killed or disabled. The whole service is working together with one end in view, that of efficiency in battle.

A recent order of the Navy Department calls for carrying out the drills with guns and fire-control parties during rain, snow and heavy weather generally, so that our men may be prepared for the most adverse weather conditions to be encountered "in action." Crews drilled in smooth water only and in fair weather are worthless when firing in rough weather in the open seas.

After the training with the mechanical targets on board ship is completed and after the loading crews are well instructed, a certain amount of ammunition is provided to fire the guns under the same conditions as would obtain "in action," so that the officers may find out definitely whether or not any particular pointer is "gun shy." During this practice a target is used on which the hits are recorded, or photographic records are kept, so that the final efficiency of the gun-pointer is obtained while the guns are actually firing. Should a pointer show any evidence of being "gun shy," he is immediately dismissed from the gun crew. The training from now on is a co-ordination of all the units; that is of all the gun crews and fire-control parties, so that when the day comes for the final test of the ship at battle practice in heavy weather, the team work will show how faithfully the individual operations have been performed.

At battle practice the conditions are made just as severe as those that would obtain in actual "action." The firing vessel has no knowledge of the course, speed, or distance of the target vessel. All the information she has is that somewhere on the horizon at a distance of 10 miles or more is a column of smoke which marks the enemy at which she is to shoot. She steams toward it at her best speed and opens fire at whatever range she chooses, but the value of hitting at long ranges is vitally impressed on her by the amount which is added to or subtracted from her score for the shots that hit beyond 12,000 yards or under that mark. The whole firing is finished in four minutes and she has no other chance to make good if she has failed in this. No excuses are accepted for failure of guns to fire, for breaking down of any gear, or for any faults of the personnel or material. The instant the target is sighted, the firing vessel must steam toward it at high speed and deliver her salvos in the shortest possible time.

Part of the most important training is that given to the "spotters," both officers and men. These are detailed in accordance with their skill at estimating distances at which the projectiles fall short or over the target at ranges of from 10,000 to 13,000 yards in the open sea. They must show a very high degree of skill, for on their accurate judgment and their cool heads during battle, depend the life of the Fleet and of the Nation. They are trained daily at "spotting boards," and at these drills the most skillful are selected to be further trained at the spotting practices, where actual projectiles are used against an armored target. At the recent spotting practice against the "San Marcos" in Chesapeake Bay it was found that salvos of eight projectiles fired at a distance of 11,500 yards could be placed on any part of the target ship.

Though the gun pointers and the gun crews are perfect, their skill is of little value if the fire-control parties are not sufficiently well trained to estimate the proper errors in range and bring the center of impact of all projectiles on the target. The demonstration against the "San Marcos" (ex-"Texas") was one of the most remarkable exhibitions of team work ever shown in the Navy. The theoretical number of possible hits at that range, if all conditions of temperature, atmosphere, steadiness of platform, skill of gun pointers, etc., were perfect, was 43 per cent. The detailed examination made by the special board showed definite evidence of 33 per cent of hits, the board further stating that so much of the ship was shot away, it might well be that many other projectiles hit the "San Marcos" without leaving a definite record.

The prizes for gunnery work on elementary practice are of little value, and in the annual battle practice each year, where the keenest interest is displayed by every officer and man in the fleet, the only reward is a little piece of red bunting with a black ball in the center, floating proudly at the mast head of the winning ship.

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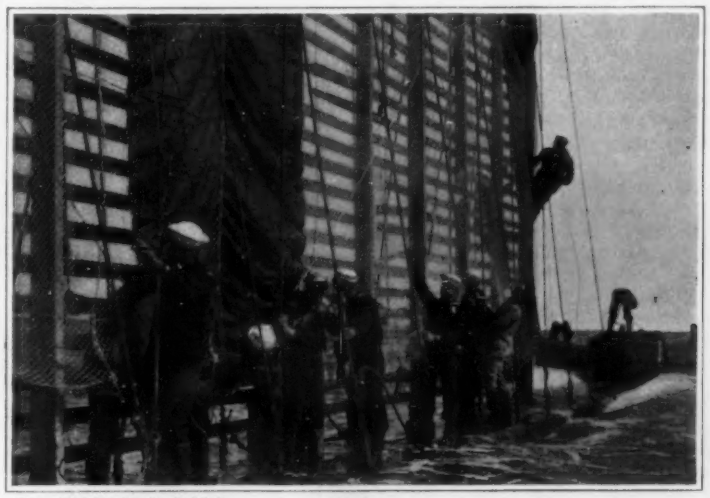
This is the splash of 7-inch shells of "Connecticut" fired at 7,000 yards range.

WATCHING FALL OF SHOTS FROM TOWING SHIP "MICHIGAN"



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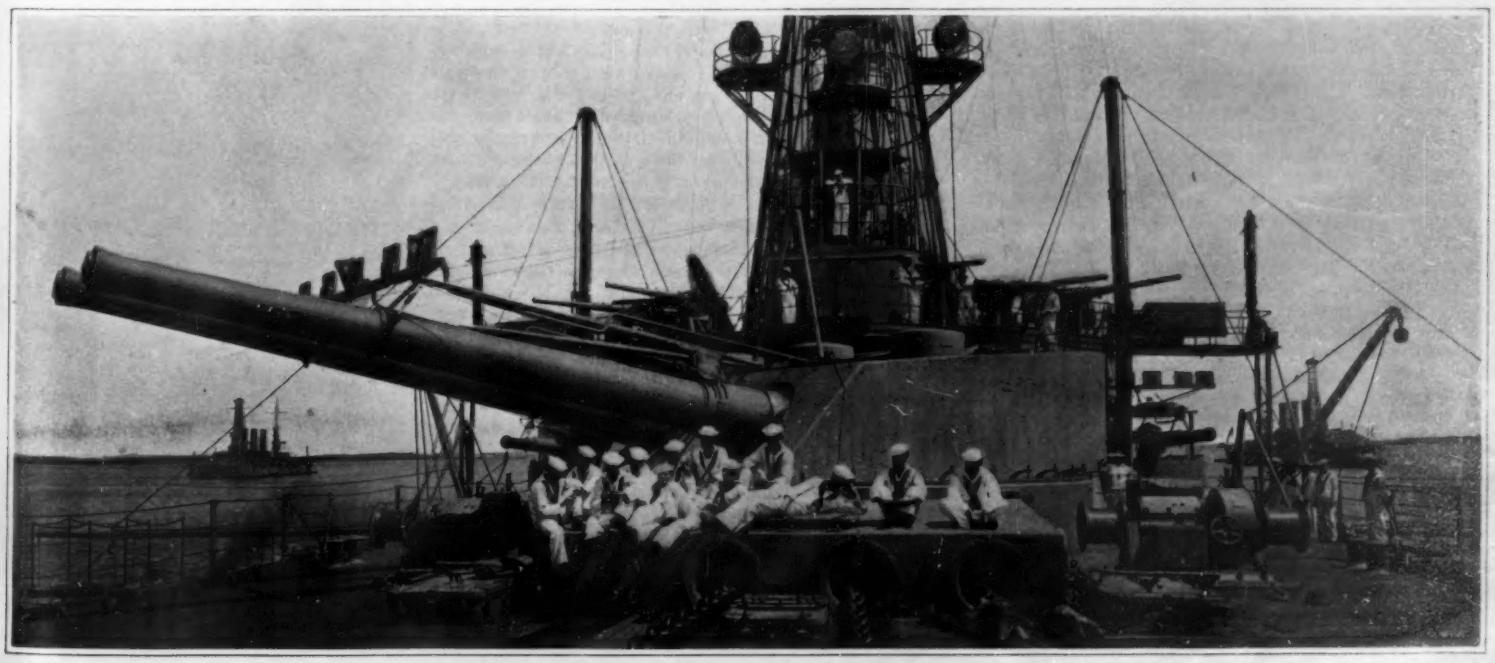
Men of the "North Dakota" on the target raft removing the net for examination.

REMOVING NET SCREEN FROM TARGET



Above the 12-inch guns is the Morris tube and mechanism used in training gun-pointers.

FORWARD TURRET OF THE U. S. BATTLESHIP "MINNESOTA"

"And there, glasses on the target, his mouth at the telephone, is the man upon whom, more than any other, depend the fortunes of the day—the spotter. A natural aptitude and long experience enable him to judge with marvelous accuracy by how much the splashes of the shells are short or over, to right or to left of, the target."

"I TELL you, sir, it's the greatest game in the world." We were in the fore top of the "North Dakota," which, having just completed the autumn practice with her 12-inch guns, was steaming in to take a look at the target. The other occupants of the platform had disappeared through the trap door in the floor, and only the Lieutenant who had done the "spotting" and I were left. "A great game, but dangerous," I suggested; "no protection; ricochet shots; high explosive shells—these masts, if the enemy can shoot like the 'North Dakota,' must come down early in the action." The officer was removing his telephone headpiece; he stopped, turned, and quick as a flash came the response: "Then it's the grandest way to die!"—and as he climbed down the chain ladder, leaving me alone, the words of the old Roman passed through my mind: "Dulce et decorum est pro patria mori" (Sweet it is and altogether fitting to die for one's native land).

"Yes," I thought, "there is the whole story: The greatest game—the grandest death—an epitome of the fine spirit of our navy."

How has it come about that this target practice, once a drudgery (I had almost said a joke), has become to the officers and men of our navy "the greatest game in the world"—great in the excitement and keen competition of the preliminary training, and great in all that it stands for as the final arbiter, when peaceful means have failed, of the fate of a nation?

If the reader of this log would know, let him fellow me, this fine October morning, as I squeeze through a door in the overhanging floor of No. 3 turret, and then scramble down, as best I may, until I stand on the double bottom of the ship, 23 feet below the surface of the water, and some 56 feet below the pair of 12-inch guns. Here I find myself in a compartment 20 feet square. Rising from its center is the base of the rotating turret structure, attached to which, and turning with it, are two elevators or "hoists," whose shell and powder cars stand ready for loading. Water-tight doors lead from this handling-room into several surrounding compartments. At the invitation of the ensign who has charge of the crew, I enter one of these compartments—the shell room. Here I see tier after tier of the huge, 12-inch, 870-pound shells, resting in strong steel racks. Overhead, and leading out to the ammunition hoist, is a trolley rail, carrying a traveling chain hoist. Returning to the handling-room, I enter another compartment, in which, neatly stored in racks, are the powder charges, each sewed up in a silk bag and inclosed in a copper case. The walls of these compartments are heavily lined with asbestos, and refrigerated air circulates throughout them, maintaining the ammunition at a constant, predetermined temperature.

I am down here to witness the drill, with dummy shells and dummy bags of powder of the same size and weight as the service shells and powder, which for weeks past has been carried out daily as part of the ship's routine. A dozen or fifteen men stand at their stations. The shell-room door is open; within it the chain hoist hangs ready for service. The powder-room door is shut; it has a circular opening, large enough for the passage of a bag of powder, which is closed by a hinged brass flap—this to prevent any accidental spark or fire from passing to the magazine.

The ensign borrows my watch. "Load!" A shell is gripped and hoisted from the rack—three men push it, on the run, to the hoist—a catch is released, and the 870-pound mass drops with a crash into the car! Meanwhile three men grab, in succession, three bags of powder, as they are thrust through the flap-covered hole in the powder room door; run with them to the hoist and drop them into the car, which, with a whirr, swoops up in a swift dash to the guns above.

"Rotten!" shouts the ensign; "lads, this will never do; you took 15 seconds; try it again." Down comes the car and the dummies are returned to their racks. Some changes are made in the stations of the men. "Load!" Another wild rush, in which a powder-bag man over-runs himself and sprawls, hugging his bag, causing the loss of a precious moment. "Twelve seconds! that is better; but you won't beat the 'Delaware' at this gait. Try again." Once more I see these eager young men (they are green hands—not many months ago they were at work on farm and in factory) standing tip-toe with eager excitement. "Load!"—"Ten seconds! Bully, lads—that will do."

A day or two later, by the courtesy of the turret officer, I stood within this same turret during the firing with full service charges, on the target-practice run. My position was against the rear wall, immediately back of the right-hand gun. To the right of the gun, at the front of the turret and immediately back of the sloping port-plate, 12 inches thick, stood the gun-pointer, his eye at the eye-piece of a periscope, whose object glass was outside the turret in a little armored hood on the side wall. The pointer's left hand was on a trigger. If that missed fire, there was another close beside it. Should that also fail, a foot-pedal would do the trick. His work was to keep the horizontal wire on the target. This he did by a lever in his right hand, which operated a powerful and wonderfully sensitive differential oil motor of variable speed. Under his hand the muzzle of the gun rose and fell as though it were a shoulder piece instead of a 50-ton mass of metal. The turret (and therefore the guns) was moved to right or left (trained) by a man whose position was between the two guns. He also was immediately behind the port-plate. He grasped a wheel (much like an auto's steering wheel), and by a differential-gear motor moved the huge mass of the turret and guns, weighing several hundred tons, as swiftly and lightly as though it were a one-pounder. He also saw the mark through a periscope, and he steadily kept the vertical wire of his telescope on the center of the target.

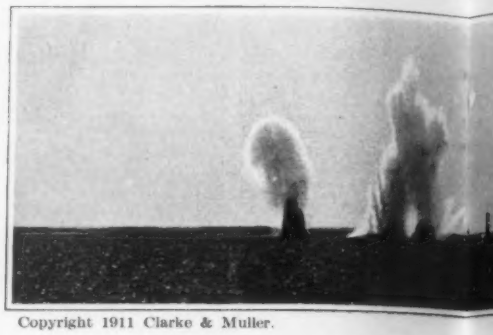
Back of our gun-pointer stood the sight-setter, telephone clamped over his ears. To him, from the central station below the protective deck, came the "range" (elevation) and the "deflection" (corrections for speed of enemy, wind, side drift of shell due to its rotation, etc.). His duty was to turn a disk till the pointer stood at the range as announced to him; and to turn, also, a little cylinder, until it registered the proper deflection.

Back of the sight-setter was a lusty and powerfully-

A Landsman's Log A
"North Dak

"The Greatest Gam

By J. Bernard Walker, Editor



Copyright 1911 Clarke & Muller.

"Later, a four-gun salvo went clean through away and throwing up the characteristic tell-

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"The plate herewith shown bears dramatic evidence of the po the temerity to stand on the forward bridge of the 'Mic he lay on his back, his camera smashed, but his pictu ble on the plate, running from left to right—mute evi

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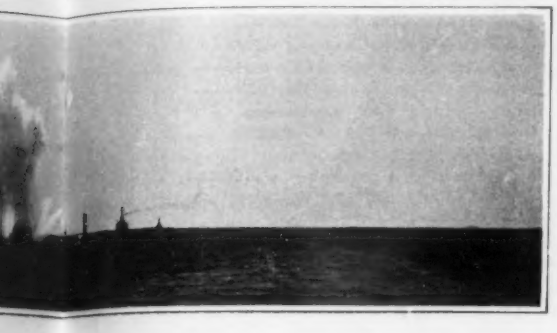
"Later in the day the net screen which covered the target wa over by the umpires, the ordnance officer, and the sp for the coveted ragged rents, with as much care as eve

Log Aboard the Battleship n Dakota"—V.

atest Game in the World"

er, Editor of the SCIENTIFIC AMERICAN



t clean through the target, tearing a large part of it aracteristic tell-tale columns of water just beyond."

idence of the power of the mighty gun blast. The photographer had dge of the 'Michigan,' to take a four-gun salvo. After the discharge, d, but his picture saved, except for the diagonal crack, which is visi- ight—mute evidence of the mishap."

l the target was brought on board, where it was carefully conned r, and the spotter, who searched every square foot of it, looking ch care as ever a prospector looked for a color of gold in his pan."

"Here, an officer is telephoning the compass readings to the fire-control station below decks. Another stands at the range-finder and calls into his mouthpiece the automatically-recorded distances to the target. A seaman at a kind of typewriter arrangement presses buttons, which serve to display the range in big numbers on the under side of the platform."

muscled young seaman, who grasped the handle of a crank, by which, through a worm gear, the massive breech-block was opened and shut. Next to him was the primer man, with his rows of primers standing conveniently to hand in a case on the turret wall. Immediately back of the breech-block was the turret captain. To the rear of him, sitting on one of a row of 12-inch shells, with his back against the rear turret wall, was I, gathering material for this log. To my left was a junior lieutenant, in charge of the crew. When I had last seen him he was in his immaculate whites and shoulder straps —now he was in dungaree trousers and a sleeveless undershirt. To his left, in line with the bore of the gun, was the electric rammer. To the left of the rammer was a man grasping the control of the electric motor that drives the rammer. Ahead of him was another man, with his hand on the control of the ammunition hoist.

A steel bulkhead separated the two guns and their crews, placed there so that an accident or a bursting shell in one compartment would not "rattle" the crew in the other. In the extreme rear of the turret, communicating through a small shutter in the door that led to each gun compartment, was a little room (booth) in which was seated the turret officer, a senior lieutenant. He was in telephonic communication with the fire-control officer (the executive officer in the conning tower, who, under the captain, fights the ship). In front of him were some electric switches and cut-outs (normally open) which the turret officer closes on notification to be ready to fire. Until he closes them the guns cannot be fired.

We are now on the range. The command is given to load. The young Hercules whirls his crank—the breech-block opens—with a rush the ammunition car comes up from below, stopping with the shell opposite the open breech—the rammer jumps forward, thrusting home and seating the shell—the rammer returns—a bag of powder falls from the car in front of the rammer and is thrust into the open maw of the gun—then another, and yet a third—340 pounds in all. Our young Hercules whirls his crank—again the massive breech-block swings into place, and all is ready for the "buzzer," sounded from the conning tower, at whose notification the gun-pointer will send the shell on its long flight to the mark.

Suddenly there came a clash and jar of the turret, not unlike the noise and shock when a train backs up rather briskly to couple up the railroad car in which one is riding; and the huge bulk of the gun jumps back some three feet, and instantly returns with a crash into battery (its normal position), the recoil occupying but a fraction of a second. Then follows a hiss of air—the compressed air-blast blowing the gases out of the gun—and the breech is open for the next loading.

Thus, with clock-like regularity we fired—six times in swift succession—and the run was over. At point-blank range, with no delay in waiting for the spotter's corrections, these 12-inch guns can be fired three times a minute.

I heard very little of the report of the guns—I was to hear that from the fire-control platform on the next run. Outside of the railroad-coupling shock and the swift recoil and return of the gun, there was nothing to tell me that, at each discharge, 50,000 foot-tons of energy had been let loose within a few feet of me—enough to lift that gun 1,000 feet into the air!

Then I left the turret, went forward and climbed the chain ladder that zig-zags inside the forward cage maat and lets you through a trap-door onto the fire-control platform. Just here, in passing, let me tell you, fellow landsmen, that if you wish for a really novel sensation in climbing, you can get it when swinging 100 feet in mid-air from an abominably flexible chain ladder, from which you look down into the black hell-mouth of a smokestack, that is doing its best to destroy your fast-expiring sense of balance by belching at you large volumes of hot furnace gas.

But, once arrived at the coveted eerie—what a spectacle! Below is the good ship "North Dakota," her deck, turrets and guns seen in plan, and looking curiously like those line-cut deck plans of Uncle Sam's ships, which you and I have seen at times on the pages of the SCIENTIFIC AMERICAN. All around and gently convexing to the far horizon, is the sea—"calm as" the proverbial "mill-pond" —reflecting in deeper tone the glorious blue of the cloudless heavens. And there, some seven miles away, is the target—a tiny, dull-gray patch, doing its 10 knots some 350 yards astern of the towing ship.

The platform is roomy; eight by twelve feet, I judge. What I see is typical of what I saw on other ships. Here, an officer is telephoning the compass readings to the fire-control station below decks. Another stands at the range-finder and calls into his mouthpiece the automatically-recorded distances to the target. A seaman at a kind of typewriter arrangement presses buttons, which serve to display the range in big numbers on the under side of the platform.

Here stand the umpires from other ships, and there, glasses on the target, his mouth at the telephone, is the man upon whom, more than any other, depend the fortunes of the day—the spotter. A natural aptitude and long experience enable him to judge with marvelous accuracy by how much the splashes of the shells are short or over, to right or to left of the target.

The speed is raised to 15 knots—we are closing in to the minimum range, for reduced charges, 9,000 yards. We may go closer than that, but if we do the results will be penalized. In monotonous tone the ranges are called off, 11,000 yards, 10,000, 9,700, 9,200, and then 9,000. I look over the breast-high rail at the guns, when suddenly there comes the flash of the first ranging shot. Fifteen seconds or so later there is a splash at the target, which, to my unaccustomed eyes, appears to be but a few feet in front of it and, surely, at its very center. I am wrong; for I hear the spotter call into his mouthpiece: "Two hundred up—two left," which means that the shot has dropped 200 yards this side of the target and two "knots" or say about 40 feet to the right of the mark.

Down to the central station, and thence to the gun, go the corrections. Mentally, I can see the sight-setter adding 200 yards to the elevation and 40 feet to the deflection. But there goes another gun, followed by another cry of the shell, and another splash, this time beyond the

(Concluded on page 532.)

The Modern Submarine

A Seaworthy and Deadly Craft, Which May Ultimately Dominate Naval Warfare

By Lieut. D. C. Bingham, Assistant Director of Target Practice, Etc., Late Commander Third Submarine Division

THE influence of sea power on the rise and fall of governments is well understood. In the past sea power has been won and held by vessels that cruised and fought on the surface of the seas, and the logical outcome is the enormous displacements of the fighting ships of all countries. Within the last decade three weapons of warfare, which in future struggles for the control of the seas are to be of great importance, have been undergoing development. These three weapons are the automobile torpedo, the submarine, and aero-craft. Too much stress cannot be laid on their influence on sea power, the submarine carrying the automobile torpedo as the destructive agency, the aero-craft acting as a scout.

A number of erroneous ideas exist in regard to the modern submarine, which prevent a thorough understanding of that type of vessel—its achievements and its future development. A few of the causes and conditions producing the above result will be dealt with briefly.

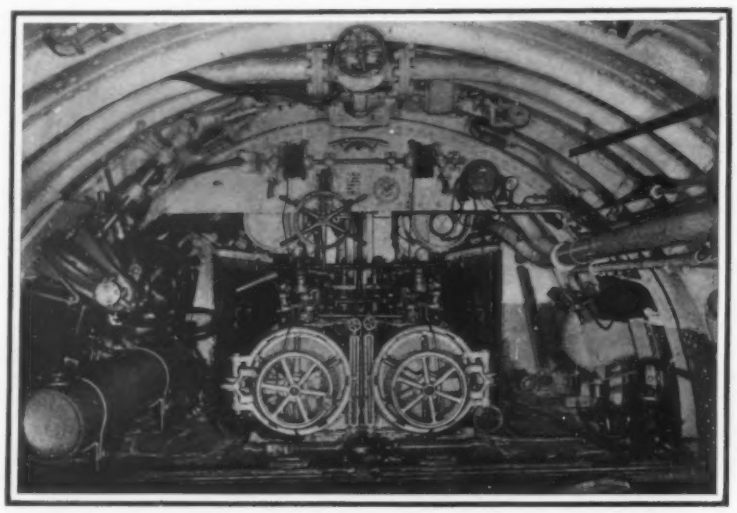
The policy of secrecy that has been maintained in the development of the submarine has led to its being looked upon as something mysterious. So long as the popular idea of a submarine is one of mystery, just so long will it fail to receive the recognition it deserves. Many unreasonable claims are made for new inventions, even those barely out of the experimental stage, and the submarine has not escaped; although now it has passed beyond the experimental stage; a fact which the progressive programmes of construction, especially in Great Britain, prove most conclusively.

Those who do not know the submarine, quickly bring to your attention certain dangers to which it is exposed, that are supposed to make it as much of a menace to itself as to other vessels. These dangers are generally grouped under the head of "explosions" and "collisions." A few moments' reflection will reveal the fact that these risks are not peculiar to the submarine, except in the case of a collision when the submarine is rising from a complete submergence. These dangers are avoided by submarines in the same way as by surface vessels; although there is more care exercised aboard the submarine than on any other type of vessel. The danger of explosion lies in the storage battery and the fuel oil, which are the sources of power respectively for submerged and surface cruising. Thousands of power boats, automobiles, etc., use gasoline without fear, and the same is true of the storage battery, except as to numbers. The danger of collision is no greater for the submarine than for surface craft, except in the case when the submarine is changing its depth from sixty feet or more to one of about twenty. At sixty feet the submarine is clear of the hulls of shipping; at twenty the shipping can be observed through the observation tubes, or periscopes. The time to rise from sixty feet to twenty is but a few seconds, and before the ascent is made it is the practice to carefully "listen in" on the submarine bell receivers for the noises made by the propellers of passing vessels, and a submarine commander is almost assured that no danger lies above before changing depth. Even the danger from collision is not so great as is generally supposed. The submarine may be divided into compartments, any one of which may be flooded without destroying the flotation; furthermore, being built to run under the surface, it is stronger in construction than those vessels designed solely for surface cruising.

The phrase, "The Mother and her Chicks alongside," which often appears in the press, cannot fail to leave an impression of weakness and helplessness. The battleship divisions of the Atlantic fleet to-day do not assemble without their repair ships, supply ships, colliers, tugs, and tenders, all of which are "Mothers," and as an effective force they cannot move away from the coast without them.

Diving to avoid collision has its share in building up the mysterious atmosphere about the submarine. It sounds well as a subject of conversation and gives a thrilling touch to a story; nevertheless few submarine commanders ever consider that method of avoiding imminent collision.

During the last half century the advance in hull construction and in propelling machinery has made of the submarine a vessel that can cruise and maneuver on the surface, that can change its depth of submergence with safety and rapidity, and that can readily maneuver submerged. Its tanks, to which water is admitted when a submergence is made, are constructed to withstand the pressure due to a depth of two hundred feet, and they are fitted with simple and quick means of admitting and discharging the water. Air pressure and large pumps driven by electricity are generally used when it is desired to free the tanks of water. Compressed air is carried in strongly constructed tanks for expelling water from the tanks and for renewing the air in the vessel during a submergence; although air renewal is not necessary for runs of under three or four hours' duration. The motive power on the surface is the fuel oil engine; under the surface it is the electric motor driven by the power of the storage batteries. In making passage from one point to another the modern submarine uses the same methods, appliances, landmarks, etc., as surface vessels. When cruising submerged with the tops of the periscopes exposed, the methods, etc., are the same, except that the bearings and observations are taken through the periscope; and when totally submerged the conditions as regards vision are the same as those aboard a surface vessel cruising in a fog, as it is impossible to see more than a few feet through the waters of the sea. The depth under water is registered on a number of water-pressure gages, and there is never any doubt as to the distance of the vessel from the surface.



In the center are the two torpedo discharge tubes. To the left is the electric motor and gear by which the doors in the nose of the submarine are opened for discharge of torpedoes.

INTERIOR VIEW ON MAIN FLOOR OF SUBMARINE "NARWHAL"

View looking forward from the bridge, showing the ample deck space.

THE SUBMARINE "NARWHAL" MAKING 14 KNOTS AT THE SURFACE

The operation of making a submergence in the modern submarine is comparatively simple and is readily understood. First, the upper deck is cleared of bridges, life lines, etc., although in time of war and maneuvers this gear is not rigged. This material is stowed inside of the submarine and can be unrigged within eight minutes. Second, the vessel is completely sealed; an operation that requires only a few seconds. The large holes in the hull are covered by doors with rubber fittings and are made watertight by the throw of a lever; the smaller holes are closed by a turn of a valve handle. Third, water is first admitted to one or more large tanks to destroy the major part of the floating power of the vessel; then to the tanks forward or aft to level her; and finally to tanks in the center of the vessel. The water admitted to the last tanks does not materially change the inclination of the vessel, and it is admitted in small quantities until the floating power is reduced to from six hundred to a thousand pounds. Gages record the results of each stage. The submarine in this condition exposes about ten feet of her periscopes and is ready for running submerged. The electric motors are then started, and the resistance of the water, acting on horizontal rudders and the deck, forces the submarine below the surface. The desired depth is obtained by giving the proper inclination to the rudders and the vessel. In fact, the control of the submarine in changing and maintaining its depth is very similar to the control of a surface vessel when making a passage on the surface. The modern submarine, starting with its main tanks free of water, can totally submerge within three minutes. Such a weapon is not and cannot be a mystery.

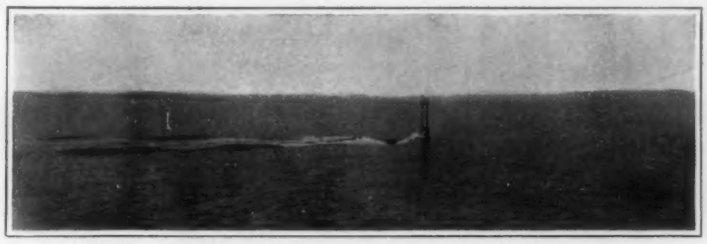
What the Submarine has Accomplished.—The record of the "Davids" before Charleston during the civil war, when a blockading squadron was kept on the move for over a year, three ships injured, and a

fourth sunk, proved at that early date the value of the submarine. The radius of action of the "Davids" was limited, that of the modern submarine is almost unlimited. The Division of Submarines now in commission on the Atlantic Coast was actively engaged in cruises, maneuvers, and target practices, from March 1st to November 1st of this year. During that time the Division cruised from Annapolis, Md., to Portsmouth, N. H., and familiarized itself with all harbors along the coast. The harbors of Chesapeake Bay, those of Newport, Provincetown, Boston, Gloucester, Rockport, Portsmouth, and Vineyard Haven Sound were successfully navigated by the submarines in the submerged condition, and, at times, much to the surprise and astonishment of the unsuspecting shipping. The submarines were often separated from the tenders for periods of two to four days and severe weather conditions of gales, snowstorms, and fog were encountered. As the conditions were successfully met from time to time, officers and crews gained confidence in the reliability of the weapon placed in their hands.

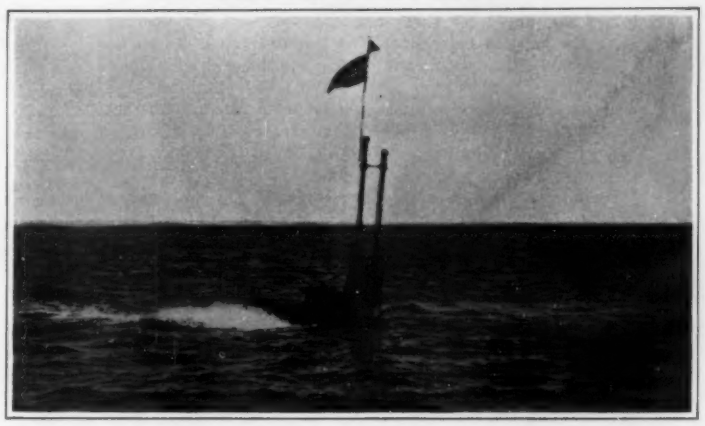
While the Division was in the waters of the Chesapeake, three- and four-day cruises away from the tenders were made for the purpose of thoroughly developing the crews. On one of these cruises a gale, accompanied by snow and hail, struck the Division when at anchor in the lower Chesapeake. The blow continued throughout the night and the following day. Two submarines lost their anchors and were forced to keep under way throughout the night; the others rode out the gale without experiencing any serious trouble. All returned the following day to Annapolis against high head winds and seas, that covered the vessels with frozen spray from the tops of the periscopes to the water lines. The ice-covered submarines were such beautiful marine pictures as they came into the harbor that the discomforts of the run up the bay were soon forgotten.

Nantucket Sound and the waters of Massachusetts Bay were repeatedly navigated in fogs. During the operations in Cape Cod Bay, twenty to thirty torpedo vessels, submarines, and surface craft would enter Provincetown harbor at night and in dense fogs. In due course of time after such an exercise, the wireless would flash the signal that all vessels of the submarine Division had returned. The most successful cruise of the Division in a dense fog was a run in close formation from the inner harbor of Gloucester to that of Provincetown without any navigation landmarks having been sighted, and except for a few minutes, the submarines were not visible from one another, although they were less than 100 yards apart. The Division had spent the week-end at Gloucester and the run was made in order that it might report ready for the night attacks on the battleships.

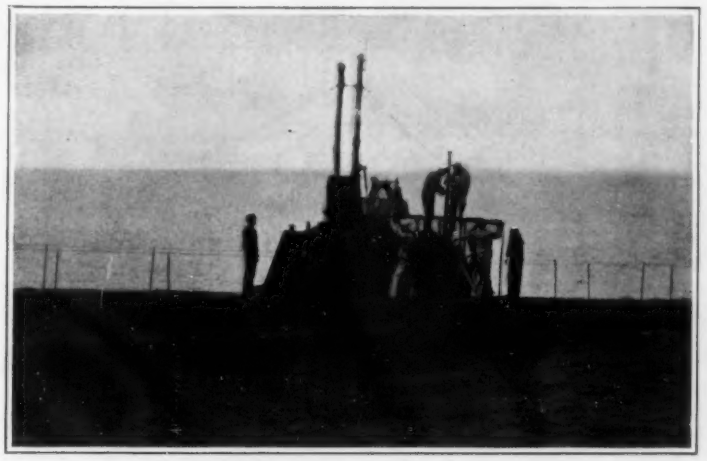
A run, that in many ways simulated war conditions, was made during June from Newport, R. I., to Gloucester, Mass., when practically the entire distance of 190 miles was made by the submarines in the submerged condition. Two stops were made, one at the entrance to Nantucket Sound, the other at Provincetown. The longest time of any one submergence was about twelve hours, and the greatest distance submerged on any one run was about fifty-five miles. During the entire run the submarines were separated from the tenders and were self sustaining in every respect. Less than sixty hours were taken for the run, although no attempt was made to make a record. The battleships, the torpedo craft, and naval militia engaged in combined maneuvers off Newport from July 18th to 20th. The part assigned to the submarine Division approached war conditions almost perfectly. All harbors from Gay Head to Montauk Point that could be used as bases by an invading fleet had to be protected. The disposition of the seven submarines was made accordingly, and they were successful beyond the expectation of the most enthusiastic. In the day problem two succeeded in attacking before the battleships anchored, the others within three hours after they had anchored. In the night attack the invading force pierced the line well to the eastward and only two submarines were successful. The exercise was declared finished before the submarines at the entrance of Long Island Sound had time to come up. The readiness with which the modern submarine can deliver an attack was vividly demonstrated on the morning of the 19th. At 3:30 P. M. on July 18th the "Grayling" anchored on the outer line between Block Island and Gay Head, ready in every respect for quick work. At night lights were screened and a watch of three set. At 4:10 A. M. of the following morning the lookout reported an armored ship to the southward and eastward, distant several miles, and standing to the northward. "All hands" were called at once, hammocks lashed and stowed, thirty fathoms of anchor cable hove in and anchor secured, and preparations made for running submerged. At 4:24 A. M., just fourteen minutes from the time of receiving the first report, the "Grayling" was submerged and running at seven and one-half knots to intercept the armored ship, which proved to be the scout "Washington." At 4:58 A. M. an attack was delivered. The scout was then standing rapidly to the eastward but later returned, and another attack was delivered. After the second attack the "Grayling" rose to the surface in order to impress the scout with the utter folly of carrying on scouting operations so near the enemy's coast. The operations of July and August in Cape Cod Bay were a continuation of the successful work in the sham battle off Block Island.



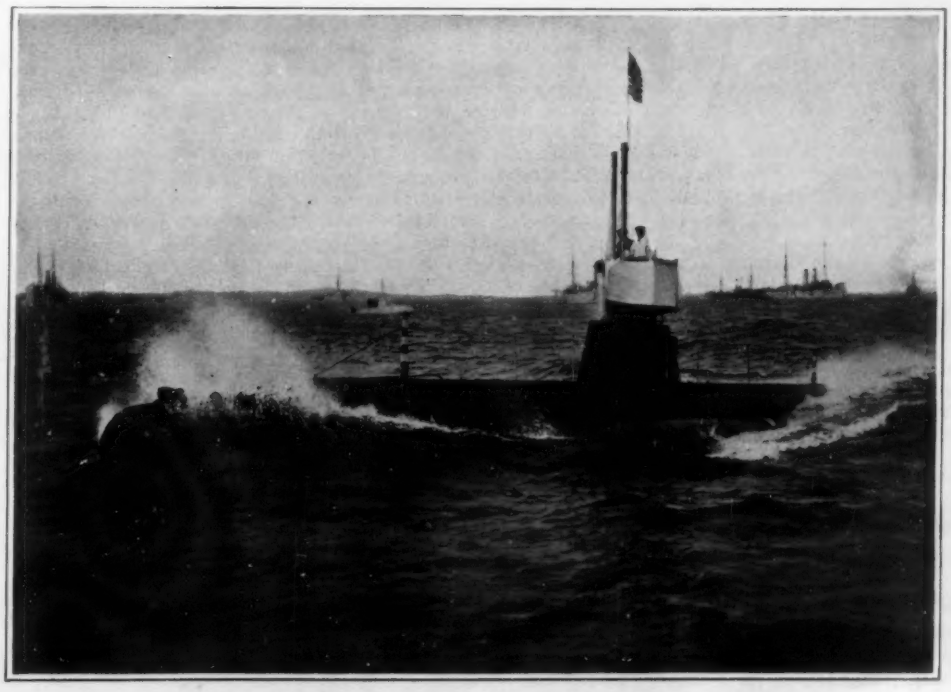
Running submerged, conning tower awash.



The diving rudders are depressed, causing the boat to dive.



Knocking down and sending below bridge and deck fittings, preparatory to submerging.



At the surface, showing conning tower, bridge and periscopes.

A method of attack developed by the "Narwhal" and "Grayling" off Gloucester is worthy of note as showing the reliance that can be placed in the modern submarine. The "Narwhal," cruising at depths of from seventy to one hundred feet directly under the "Grayling," which was submerged to a depth of fifteen feet, was directed by the "Grayling" for over two hours. The speed of both vessels was seven and one-half knots and the means of communication was the submarine bell apparatus. When the "Narwhal" rose to the surface in obedience to a signal from the "Grayling" she was in her designated position.

The mobility of the Division is shown by the distance cruised during the eight months away from the navy yards, viz., 25,000 miles on the surface and 3,800 submerged. The achievements have been accomplished with submarines developed by a commercial company, and it is reasonable to suppose that they will be greater when their development is undertaken by the navy.

In view of what the submarine has done can anyone doubt its future?

The Submarine Compared to Other Types of Warships.—The essential military characteristics of a man-of-war are, sea-going and sea-keeping qualities, invulnerability, and powerful and destructive armament. A man-of-war to be sea-going and sea-keeping must be seaworthy and habitable in all conditions of weather and sea; its motive power must be reliable, it must be readily handled and maneuvered; and it must have a large radius of action. The modern submarine is built to stand the great pressure due to 200 feet submergence;

(Continued on page 534.)

The Fleet and Its Readiness for Service

(Continued from page 515.)

Vessels Built.

[March 1, 1911.]

	Battleships, Dreadnought Type.[1]	Battleships.[2]	Armored Cruisers, Invincible Type.[3]	Armored Cruisers.	Cruisers.[4]	Destroyers.	Torpedo Boats.	Submarines.	Coast-Defense Vessels.[5]
England	8	47	4	34	81[6]	176[6]	59	68	.....
Germany	4	32	1	9	41	93	27	8	6
United States	4	35		12	30	30	28	18	5
France	.....	17	.....	21	12	65	225	60	3
Japan	.....	13	2	11	16	57	59	9	3
Russia	.....	9	.....	7	11	97	45	31	2
Italy	.....	9	.....	10	7	23	58	7	..
Austria	.. ..	5	.....	3	6	14	47	6	6

[1] Battleships having a main battery of all big guns (11 inches or more in caliber).

[2] Battleships, first class, are those of (about) 10,000 tons or more displacement.

[3] Armored cruisers having guns of largest caliber in main battery and capable of taking their place in line of battle with the battleships. They have an increase of speed at the expense of carrying fewer guns in main battery, and a decrease in armor protection; also called battleship cruisers.

[4] Includes all unarmored cruising vessels above 1,000 tons displacement.

[5] Includes smaller battleships and monitors. No more vessels of this class are being proposed or built by the great powers.

[6] Includes vessels of colonies.

Vessels Building or Authorized.

[March 1, 1911.]

	Battleships, Dreadnought Type.	Battleships.	Armored Cruisers, Invincible Type.	Armored Cruisers.	Cruisers.	Destroyers.	Torpedo Boats.	Submarines.
England[1]	10		5[2]	.....	16[2]	39[2]	..	18[2]
Germany[3]	9	....	3	.....	4	18	..	12[4]
United States	4	.....	.....	.....	.....	12	....	16
France	2[2]	5	.....	1	.....	20	2[2]	28
Japan[5]	2[2]	....	1	.....	5	4	..	4
Russia	4	..	..	.....	.....	3	.....	2
Italy	4	..	..	..	3	10	50	13
Austria	2[6]	1	.....	.....	.....	.....	.....	6

[1] England has no continuing shipbuilding policy, but usually lays down each year 5 armored ships, with a proportional number of smaller vessels.

[2] Includes vessels of colonies.

[3] Germany has a continuing shipbuilding program, governed by a fleet law authorized by the Reichstag. For 1911 there are authorized 3 battleships, 1 armored cruiser, 2 cruisers, 12 destroyers. Eventual strength to consist of 38 battleships, 20 armored cruisers, 38 cruisers, 144 destroyers.

[4] $3,570,000 authorized for experiments and further construction.

[5] One more battleship, 2 more armored cruisers, 1 more cruiser, and several destroyers and submarines authorized to be laid down and completed by 1916.

[6] Building under agreement with navy department before authorization by Delegations.

NOTE.—The following vessels are not included in the tables: Those over 20 years old, unless they have been reconstructed and rearmed since 1900; transports, colliers, repair ships, converted merchant vessels, or any other auxiliaries; vessels of less than 1,000 tons, except torpedo craft; torpedo craft of less than 50 tons.

A Landsman's Log Aboard the Battleship "North Dakota"—V.

(Continued from page 529.)

target. "One hundred down," says the spotter. "What next?" I ask of an officer standing near me. "A six-gun salvo—have you got your ear-protectors in place?" I am raising my hands to press the little bulbs more snugly in position, when there bursts forth a Titanic crash! My whole frame feels as though some unseen hand had struck it a violent blow; and I find myself flung, in the effort to keep my footing, entirely across the platform in the direction of the target (the effect of the recoil) and then flung backward, and then alternately forward and backward, until the fierce whipping of the mast subsides.

The spotter looks over his shoulder at me and points at the sky, and there, I see six, sharply-defined, circular, black spots, symmetrically disposed, in pairs, on a long horizontal line across the heavens—the six shells.

"Baron Munchausen?"

Nay, good reader, question not my veracity; it is a common phenomenon and may be seen at any big-gun target practice when the weather is clear, as it was that day. Steadily, the little ink-black spots diminished and drew together under the influence of the perspective, rising gradually to the highest point of their trajectory, when they faded from sight.

The fire-control platform has quickly steadied to absolute quiet; and we listen with keen attention for the spotter's verdict. Up go those magnificent, flashing bursts of pulverized water; and I hear the spotter call into the mouthpiece: "A straddle," which means that some of the shells have dropped in front and some beyond, making the average of the whole six a hit on the target itself.

Later, a four-gun salvo went clear through the target, tearing part of it away and throwing up the vast tell-tale geysers just beyond.

The physical effect of the blast of these 12-inch guns is something that defies description; but the plate shown on page 528 bears dramatic evidence of the power of the mighty air-wave. The photographer had the temerity to stand on the forward bridge of the "Michigan" to photograph a four-gun salvo from turrets 1 and 2. After the discharge, he found himself on his back on the after side of the bridge, his camera smashed to fragments, but his picture saved, except for the diagonal crack which will be noticed in this illustration, running from left to right—mute evidence of the mishap.

Dramatic in every way is a salvo of the main batteries of a modern battleship. Its appeal to the eye may be judged from the handsome photogravure insert which is inclosed within the present issue.

Later in the day, the net screen which covered the target was brought on board, where it was carefully conned over by the umpires, the ordnance officer, and the spotter, who searched every square foot of it, looking for the coveted ragged rents with as much care as ever a western prospector looked for a color of gold in his pan. The four-gun salvo that carried away a part of the target cost the "North Dakota" dear; for a considerable portion having disappeared, by the rules of the game, and indeed by the necessities of the case, any later shots that may have passed through the gap did not count. For this and other reasons, I could not understand the disappointment of that ship's company when they learned the result—four hits and six ricochets. Credit should be given for the fact that since, for economy, three-quarter powder charges were used, the sight-bar range was actually about 13,000 yards, or between six and seven miles. To me at least this was a fitting and altogether satisfactory climax to that never-to-be forgotten cruise aboard the "North Dakota."

If the present log has served to give the people of the United States a clearer knowledge of the fine work which is being done in the United States Navy, not only by the "man behind the gun," but also by the man behind "the man behind the gun," it will not have been written in vain.

The landsman's thanks are due to George von L. Meyer, the Secretary of the Navy; to Admiral Hugo Osterhaus, Commander-in-Chief of the Atlantic fleet; and to Capt. Albert Gleaves and the officers of the good ship "North Dakota" for the many courtesies extended during my stay with the Atlantic Fleet on the Southern Drill Grounds.

(End of Landsman's Log. For earlier chapters see issues of October 14th and 28th and November 11th and 25th.)

Our Rank Among the Naval Powers

(Continued from page 523.)

increase the number of merchant vessels flying the American flag, the navy will have to depend upon its own colliers in time of war, or purchase or charter merchant vessels in foreign countries—probably the former, as the risks under charter would be considered too great. Such a procedure would be most uneconomical, as greatly increased prices would no doubt be demanded, our needs being known.

In the event of actual hostilities, the supply of ammunition to a fleet is the most important factor. The battleships of the present day carry ordinarily about 100 rounds for each of the heavy guns. In the event of hostilities, by stowing magazines and shell-rooms to their fullest capacity, this amount would probably be increased to about 120 rounds per gun.

When we take into account the rapidity of fire of the heavy guns of a modern battleship, and the range at which an action will begin, it would not seem improbable if the total amount of ammunition would be shot away in an engagement with an enemy without either fleet gaining such a marked advantage as to make the action decisive and final.

If such action takes place in close proximity to the shores of the enemy, it would not be very difficult for its fleet to withdraw temporarily to a fortified basis and replenish rapidly its magazines and shell-rooms. The question presents more formidable difficulties for a fleet operating at a great distance from a base. Ammunition must be carried to the fleet in properly equipped ammunition ships; ships so fitted as to be able to rapidly discharge their ammunition into the battleships. Arrangements can be made by which a limited amount of ammunition can be carried by all auxiliaries, including colliers, supply ships, repair ships, transports, etc., but these ships must be especially fitted for carrying the ammunition, and at the best can carry but a limited quantity.

Other necessary adjuncts of a well balanced fleet are repair ships, hospital ships, transports and mine laying vessels.

Repair Ships.

It is believed that if any fleet is accompanied by a sufficient number of properly equipped repair ships, it will be necessary for said ships to visit our dock yards only at very distant intervals, primarily for cleaning their bottoms. Numerous small accidents to the machinery or appurtenances of a modern battleship can be readily and efficiently repaired by a properly equipped repair ship. After an action between two fleets, the value of a repair ship cannot be over-estimated. Many ships of the fleet may be damaged in such a way that they can be temporarily repaired and fitted to take their place again in the line of battle by a repair ship.

The United States possesses but one ship of this type as opposed to three in England and two in Germany, and while the Merchant Marine of this country may possibly furnish a number of ships suitable for this purpose, time will be required to install in such ships a proper equipment.

Hospital ships, while a necessary adjunct to the fleet, can undoubtedly be acquired by purchase or contract of vessels under the American flag or in foreign countries, as said vessels act under the Red Cross Agreement and are not to be considered as subject to capture so long as they perform the duties for which they are designed. Transports for the conveying of bodies of troops and advanced base outfits can probably be acquired by purchase or contract preceding hostilities, and will probably only be needed in the event of distant operations of the fleet, where it becomes necessary to seize and defend a base, to which vessels of the operating fleet can repair at intervals for coal, fuel, ammunition, or other supplies.

Submarines.

In the present state of naval development, the submarine is essentially a vessel designed as an important part of the mobile defenses of our coasts or outlying possessions. It is understood that the French Government is now designing and building a type of submarine, which it is believed will be able to accompany the fleet even in distant operations, its radius of action and habitability having been developed to the extent which makes such a use of this type of vessel a probable success. Of this type, the submarine, England possesses seventy-four, Germany fourteen, United States twenty-six, France sixty-six, Japan ten, and Russia thirty-one.

Personnel.

When we come to consider the number of commissioned officers and enlisted men available for duty in the fleet, we find that the United States Navy is sadly deficient. Although the number and size of our vessels of war have increased very largely in the last ten years, there has been no proportionate increase in the commissioned personnel of the Navy. If the Navy Department were called upon to-day to commission all of its fighting vessels now in reserve, and which, in the event of war, it would be necessary to place in service, it would be impossible efficiently to officer and man these vessels. Of late, when it has been found necessary to commission some new battleship, cruiser, or even torpedo destroyer, it has been found equally necessary to place some vessel of the same type in reserve or out of commission, in order to provide the personnel for the new ship.

It is difficult to compare conditions between countries which have compulsory military service and countries where service in the navy is purely voluntary. England, although compulsory military service does not exist, maintains a very strong reserve of both officers and men. In all other European navies compulsory service exists, so that these countries are from year to year building up a reserve of officers and also of trained men, who have served at least three years with the colors.

In Germany this is a most important factor, as with their system, which carries a man along either in active service or in the reserve until he reaches the age of 45 years, a very large body of trained men is available, in the event of hostilities, for commissioning all ships in reserve, or for other purposes. So far as the commissioned personnel of the United States Navy is concerned, it compares most favorably in education, training and experience with that of any other country, but in numbers it is wholly inadequate for the present and future needs of the Navy.

The analysis of the composition of the various fleets, by which their strength and relative rank is measured, shows that Great Britain holds, beyond a shadow of a doubt, the first place. Considering the navies of the United States, Germany, France and Japan, it is clearly seen that the United States outranks France and Japan, as the superiority of our battleship fleet is so great as to offset every advantage they may possess in the other elements which make up naval strength.

To establish the relative positions of Germany and the United States is more difficult. Our only superiority lies in the battleships themselves; in all other essentials of fleet strength, we are outranked. Giving due weight, however, to all factors, it would seem that at the present writing the margin of superiority rests with our fleet, a margin so slight that, considering vessels building and authorized, two or three years will undoubtedly relegate the United States fleet to third place among the nations.

The Most Extraordinary Tests to Which Musical Instruments Have Ever Been Subjected

Twenty-six Pianola Pianos on the 45,000 Mile Cruise of the American Battle Fleet

When Admiral Evans' fleet began its memorable cruise around the world from Hampton Roads, there were twenty-six Pianola Pianos distributed among the different ships.

The Battle Fleet covered over 45,000 miles in its trip, crossing the equator four times. It passed from the extreme cold of the Straits of Magellan to the heat and humidity of the tropics.

During target practice in Magdalena Bay and at Manila every object on board was subjected to terrific strain. In one instance, the force of concussion as the big guns were fired, was sufficient to bend in the steel bulkheads of one of the mess-rooms, where a Stuyvesant Pianola Piano was installed.

In two cases, during the storm encountered between Manila and Yokohama, Pianola Pianos broke loose from their fastenings and were hurled to the other side of their mess-rooms, before they could be secured.

Yet the Pianola Pianos in these rooms when examined four months later needed only slight adjusting and were very little out of tune.

These Pianola Pianos were the common property of the different messes to which they belonged. They were not played by one or two people as would be the case in a private home, but were used by anywhere from a dozen to a hundred or more different individuals.

According to the testimony of the officers and men, the different Pianola Pianos were played almost continuously during the whole fourteen months of the cruise, and shared with the big guns the interest of all visitors who came aboard.

On the return of the fleet, a special representative of the Aeolian Company was sent to Old Point Comfort to inspect these instruments. *Without exception every Pianola Piano examined was found in excellent playing order.*

Besides tuning and such slight regulation as fourteen months constant use would naturally involve, they were practically in *as good condition as when the fleet departed.*

* * * * * *

It is of the utmost importance that the distinction between the Pianola Piano and other so-called Player-pianos be understood. Only pianos containing the genuine Pianola and bearing the word "Pianola" upon the fall-board are Pianola Pianos. In the means it provides for artistic playing—in its musical quality as a piano and in its durability as assured by the thoroughness and fidelity of its construction—the Pianola Piano occupies a class apart from, and superior to all other instruments of its type.

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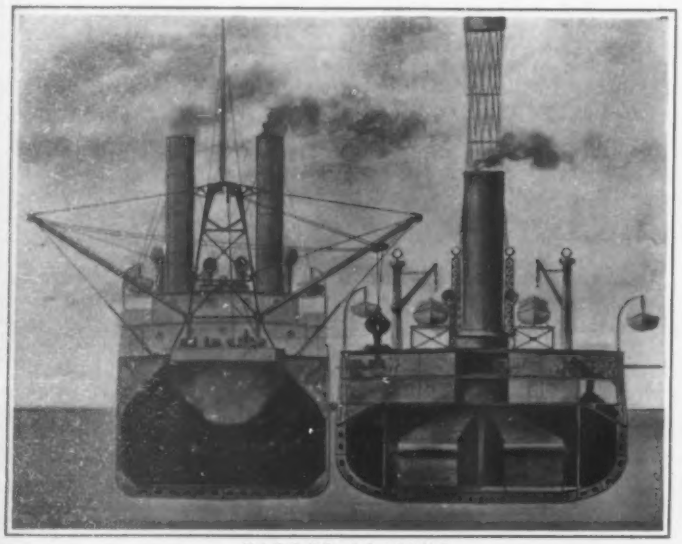
The U. S. Collier "Vestal," fitted with the Lidgerwood-Miller Marine Cableway, delivered under test 72½ tons of coal in one hour to the U. S. S. "Virginia," 400 feet distant in tow, speeding 12 knots per hour. ***The Marine Cableway will operate in any sea fit for towing a battleship.***



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The U. S. Colliers, "Neptune," "Vestal," "Prometheus," "Mars," "Vulcan," and "Hector" are fitted with the Lidgerwood-Miller Marine Transfers and Colliers Nos. 11 and 12 will be so fitted.

One Man on the Collier "Neptune" can discharge 100 Tons of Coal per hour to a vessel alongside. **The "Neptune" has twelve Marine Transfers.**

LIDGERWOOD MFG. CO.

96 LIBERTY STREET, NEW YORK, N. Y., U. S. A.

Recent Development in Ordnance

(Concluded from page 531.)

Armor.

There has been no important advance in quality of armor since the Krupp process of hardening was introduced about fourteen years ago; during this period the side armor belts of our battleships have been of from nine to eleven inches thickness. To meet the increasing power of guns and penetrative effect of projectiles, a tendency toward increasing this thickness to twelve or thirteen inches is evident, and the Bureau of Ordnance has even had one experimental eighteen-inch plate made and tested with a view to possible future demand for armor of that thickness.

That the art of armor making has not stood still, in spite of there having been no radical changes in methods, is shown by the two photographs on page 520. The former shows an armor plate produced in 1905, and the latter a plate produced in 1911, against each of which three projectiles have been fired. In the one case the flaking of the hard surface was excessive, in the other almost *nil*. It will be noted that neither plate was completely penetrated.

Thin plates, which are not technically classed as armor, have been much improved in resisting power by changing the alloy used; a nickel-chrome-vanadium alloy has been adopted, and this when specially treated produces turret and conning tower tops of great resistance.

Experimental Work.

Much valuable information has been obtained by experimental firing at the U. S. S. "Katahdin" and "San Marcos" (formerly "Texas"). Each of these is a vessel of small military value, but capable of affording an actual target for experimental firing. The "Katahdin" was fitted with armor plate targets erected on her upper deck; one target represented the side of a battleship, the other a turret barbette, and in both the armor plate was braced by appropriate framing and structures. Firing was conducted with a 12-inch gun on board the U. S. S. "Tallahassee" at ranges of 7,700 to 8,500 yards, using service ammunition, but not with explosive shell, as the object was solely to determine penetrative effect. Two hits were scored on each target with resultant complete penetration of the armor, as was expected in accordance with theoretical calculations. The results of this test also proved that a projectile while in flight is at all times tangent to the trajectory.

The "San Marcos" furnished a target for more extensive firing, the greater part of which was conducted by the U. S. S. "New Hampshire" for purposes of gunnery training of the personnel. The most striking lessons of this firing were:

(1) The fact that, at ranges of 10,000 and 12,000 yards, the "New Hampshire" could place her shots on any portion of the ship at will, thus proving the accuracy of her spotting and pointing.

(2) The tremendous havoc wrought in the "San Marcos" by the passage or bursting of entering shell.

Modern Submarines

(Concluded from page 531.)

therefore it is apparent that none of the surface elements can damage it. Its natural subdivision into tanks for submerging purposes gives it a safety which every surface craft strives for by putting in double bottoms. There is no smoke, no leaky or hot steam pipes, or any other of the numerous disadvantages of the ordinary surface vessel. The reliability of the motive power, the internal combustion engine, is assured, and the modern submarine being a twin-screw vessel is readily maneuvered. The radius of action of submarines now under construction exceeds 5,000 miles on the surface and 100 submerged, the maximum speed on the surface being 13½ knots, that submerged 10½ knots. Ten miles is the farthest that a submarine can be seen on the surface, and its submerged radius of action is such as to permit many hours of maneuvering unseen and unsuspected, beneath the surface. The comfort of the crew depends entirely on the weather and sea as it does in all craft. The submarine may escape from heavy weather

(Concluded on page 536.)

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

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"Built like a watch but as rugged as a battleship"

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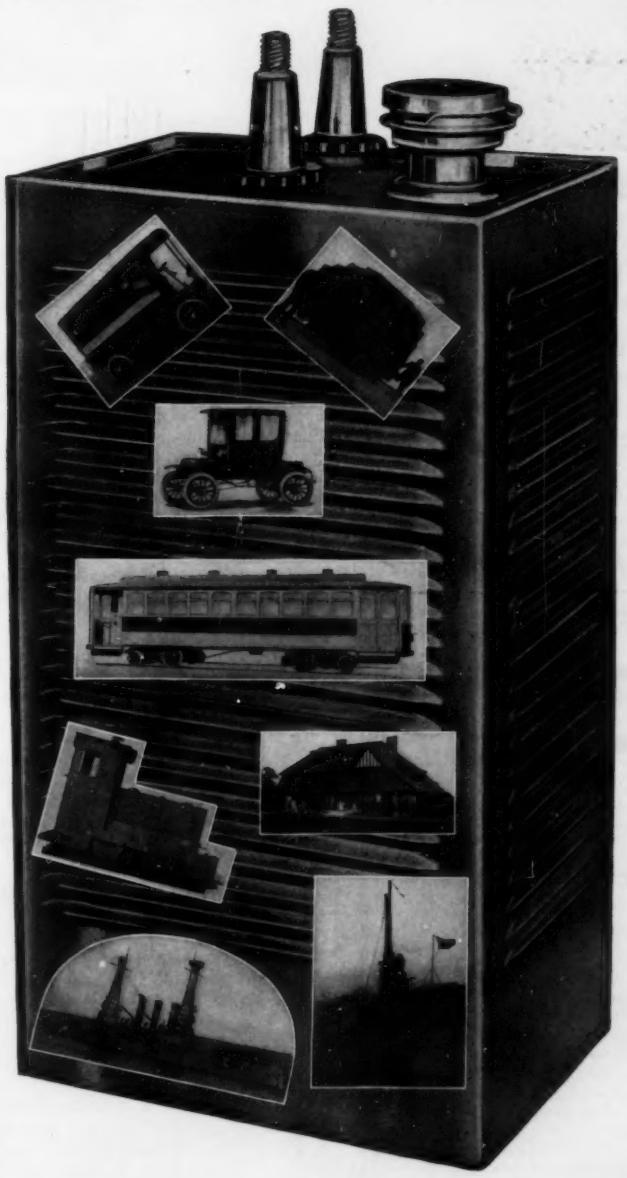

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APPROVED:

Thomas A Edison

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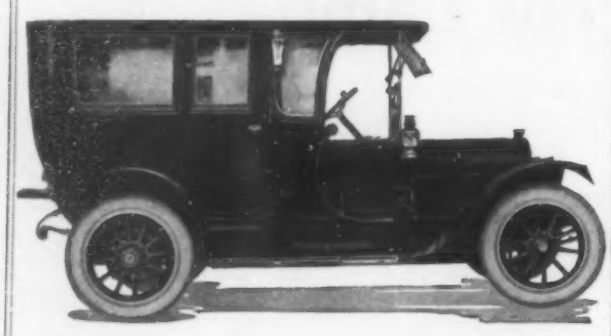

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Motor Trucks

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And 62 per cent of all Alco Trucks are Re-orders.

BIG concerns own Alco Trucks—big concerns like the American Express Company, Gulf Refining Company, Barrett Manufacturing Company, Gimbel Brothers, Standard Oil Company, Singer Sewing Machine Company.

Big companies, like big men, don't make many big mistakes.

They are shrewd. They know.

Sixty-five per cent of all Alco Trucks are in the service of companies rated in Bradstreet's at $1,000,000 or more.

This is only natural, for the American Locomotive Company is itself a big company. Capital $50,000,000. And of considerable transportation experience—dating back to 1835. Builders of 50,000 locomotives.

Knowing this, these big companies felt that the American Locomotive Company *ought* to build a good truck. It had experience no one else possessed, extensive capital, large physical equipment, an organization already at work. Whether or not it really *had* built a good truck must be determined by actual service.

This was the logical reasoning upon which nearly every single big company made its *first* Alco purchase.

And since its first purchase every single big company has ordered *more* Alco Trucks! Every single one!

And sixty-two per cent of all Alco Trucks were purchased on such repeat orders!

In the service of Department Stores 78 per cent are re-orders; Oil Refiners, 74 per cent; Express Companies, 64 per cent; Packers, 53 per cent; Brewers, 50 per cent—the five lines of business in which motor trucks are most used today.

Repeat orders speak with eloquent emphasis of satisfied owners—stronger than mere claims—*powerful* testimonials.

These are compelling facts. They tell the smaller business man that he can avoid an unwise purchase if he selects the Alco.

They are evidence which must determine the verdict.

Our new book is full of vital facts. Write for it today.

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by remaining under the surface. This was actually done by the "Snapper" in 1910, when she remained on the bottom off Boston Light Vessel in seventy feet of water for 12½ hours.

The invulnerability of the submarine is well nigh perfect. In its approach, after sighting the enemy, its invisibility affords better protection than any armor or watertight subdivision that has been put abroad a surface vessel. The exposure of as much as five feet of one or more periscopes, each six inches in diameter, is necessary, in an attack, for periods of two to five minutes, although with that amount of the periscopes exposed there is still fourteen feet of water over the hull, which is ample for protection.

The armament consists of the torpedo tube and the torpedo. History teaches that the gun has always decided the naval battle, and admitting that to be true, may there not be a change in the character of the gun? It is a very simple matter to designate a torpedo tube as a gun and a torpedo as a projectile. In fact the similarity is so marked that it is surprising that they were not so named at the beginning.

Let the world become imbued with the belief that in the modern submarine there is nothing wonderful, weird, or unusual, and that duty aboard is not a hazardous undertaking, and a new era in the development of naval warfare will have commenced.

A Geographical Excursion Across the United States

IT is announced that the American Geographical Society, which celebrates its jubilee next year, is planning in connection therewith a transcontinental excursion for the purpose of geographical study, in which delegates from the geographical societies of other countries will be invited to participate. The party will be "personally conducted" by Prof. W. M. Davis, of Harvard, who has lately had experience in carrying out similar undertakings in Europe. It is expected, also, that the American members of the party will, so far as they are able, act as guides for the foreign visitors. While the natural features of the landscape are to be the principal objects of observation, attention will also be paid to the agricultural and industrial development of the country.

It is expected that the excursion will leave New York some time in August, 1912, on a special train, and will spend six or seven weeks in traversing the country. The itinerary, as now planned, is to include, among other points of interest, the highlands and gorge of the Hudson, Niagara, the shore-lines of old lakes in Ohio, the southern end of Lake Michigan, with its artificial outlet into the Mississippi system, the upper Mississippi and Missouri, the Yellowstone Cañon and National Park, the Rockies of southern Montana, the Cascade Range, Seattle, and Puget Sound. The return will probably be made by a southerly route.

Fishing With a Steam Pump

ONE of the most singular fishing devices imaginable was discovered by accident in France. Though extremely simple, the system is revolutionary.

A pond on the farm of La Marlequette, bordered by rocky shores, was drained one year by the aid of a steam pump. Each stroke of the piston drew up twenty-five gallons of water and the pond was emptied in a few hours; and not only was the water drawn off, but all the fishes also were transferred to a new element.

This was a revolution. The owners of ponds in the neighborhood followed suit, and the proprietor of the pump made a specialty of this sort of work. He "let" one of his pumps, modified for the purpose. The peasants of the region called it "the fish pump." Each stroke of the piston brought up torrents of water, in which were fish and crawfish, together with mud and débris.

One pond of several acres was cleared of fish at an expense of 36 francs, or $7.20. The process was ingenious, but as one cannot have his fish and eat it, too, and as such rapid consumption would have led to equally rapid extermination, the local authorities were obliged to take measures to stop the practice.

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"Cravenette" is a proof, not a cloth

It is the only proof that will make any cloth *permanently rainproof without the use of rubber*. It permeates every fibre of the yarns of which a cloth is woven, rendering them **thoroughly rain proof.**

This proof prevents a cloth from becoming water-logged, soggy, heavy or wet from rain, snow, fog or dampness of any kind. It is permanent, contains no rubber and does not change the appearance of the cloth in the least.

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The briar bowls used in all "Defi" pipes are seasoned by a scientific secret process.

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For Christmas. Style M, genuine amber bit, beautiful silver mounting in a handsome leather case, with holiday packing, $5. *Correspondence from reliable dealers desired*

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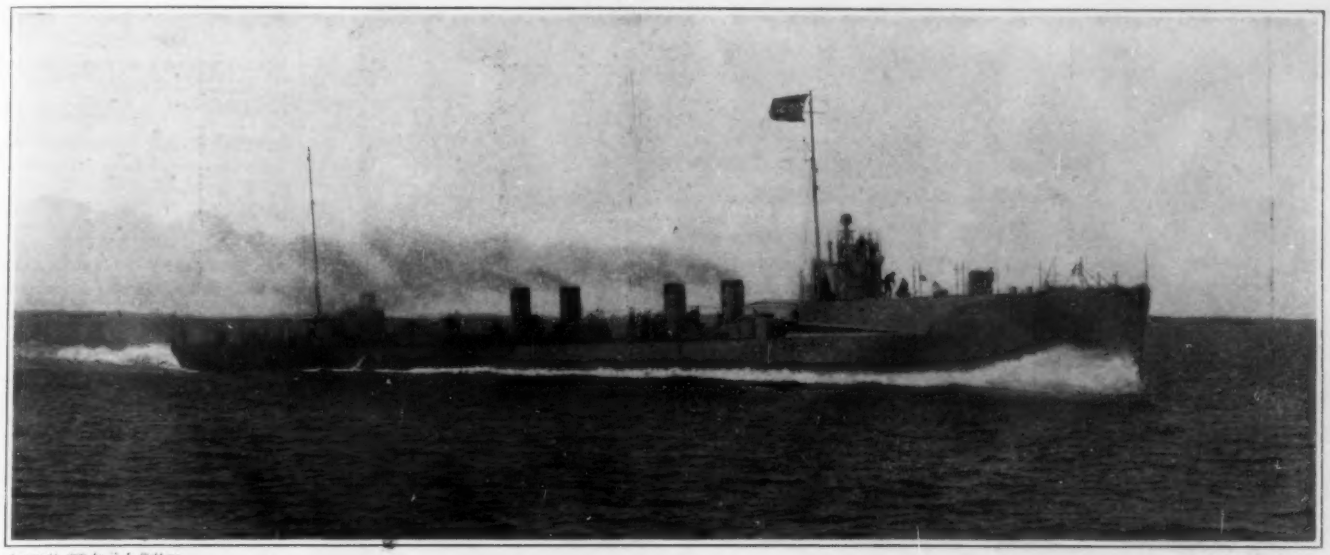

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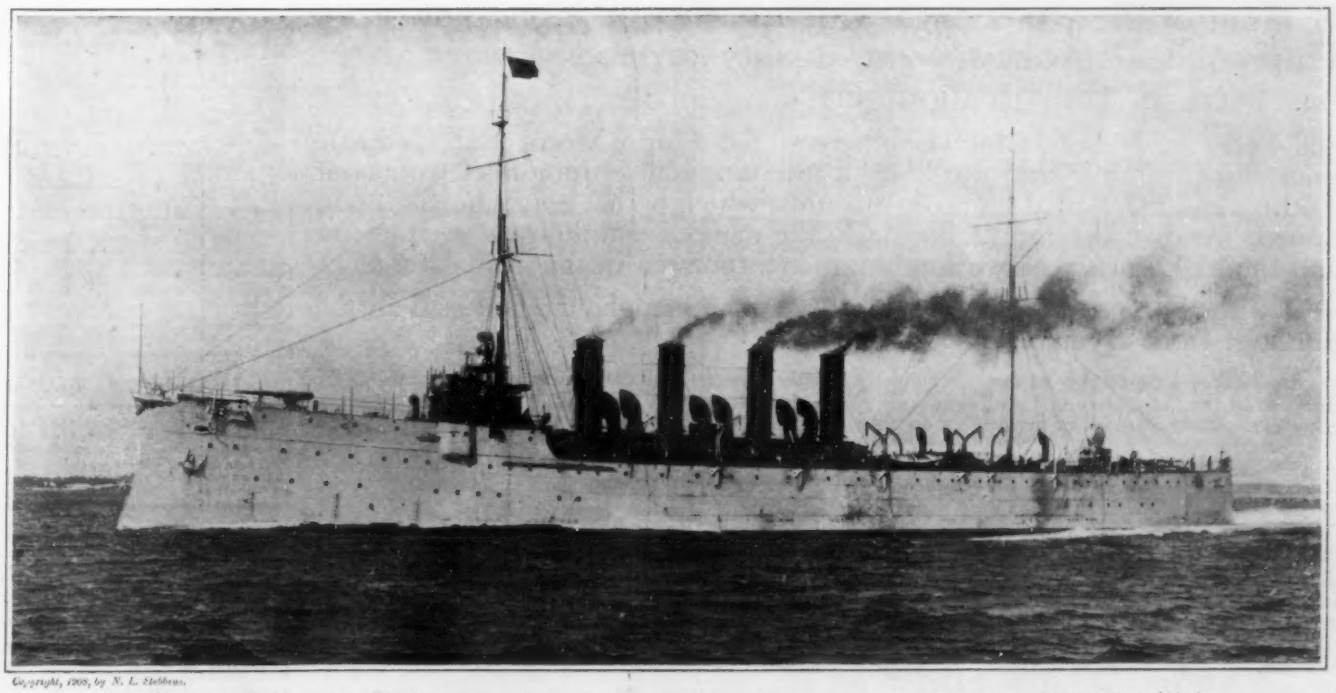

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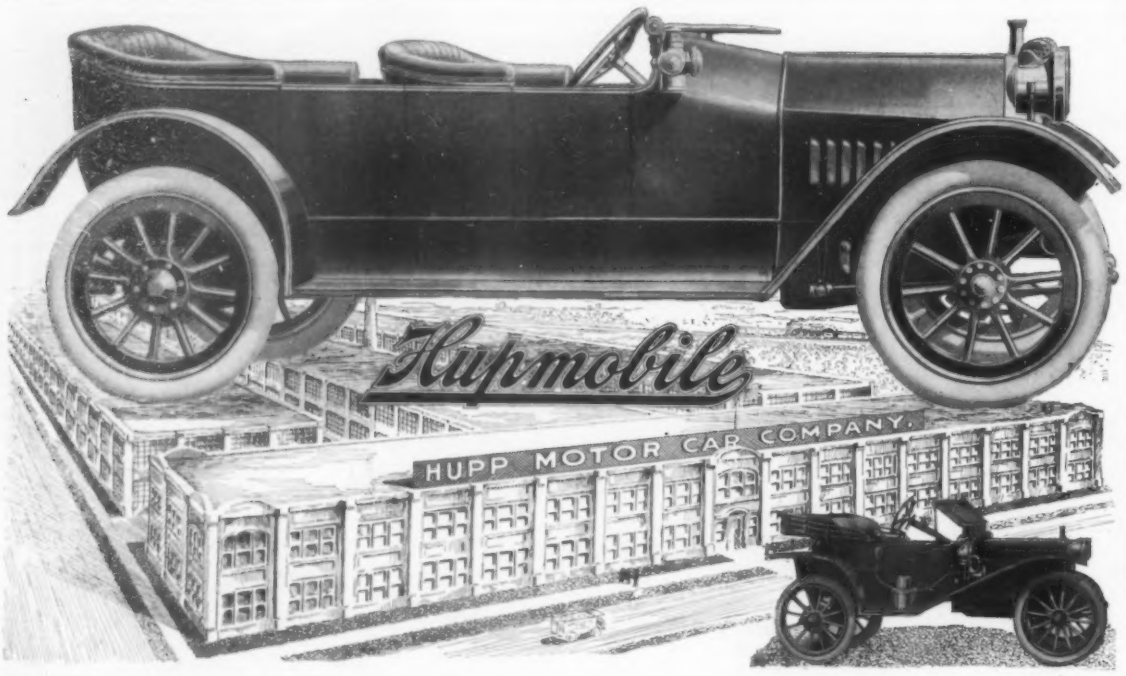
Length, 420 feet. **Beam,** 47 feet. **Displacement,** 3,750 tons. **Speed,** 26.5± knots. **Maximum coal supply,** 1,250 tons. **Armor:** Deck 1½-inch.
Guns: Two 5-inch; six 3-inch. **Torpedo tubes,** two 21-inch.

U. S. Scout Ship "Chester"



Hupmobile Long-Stroke "32" Five Passenger Touring Car—$900

F. O. B. Detroit, including equipment of windshield, gas lamps and generator, oil lamps, tools and horn. Three speeds forward and reverse; sliding gears. Four cylinder motor, 3¼-inch bore x 5½-inch stroke. Bosch magneto. 106-inch wheelbase. 30 x 3½-inch tires. Color—standard Hupmobile blue.

The new touring car will be first exhibited at the Grand Central Palace, New York, Jan. 10-17; and subsequently at the principal automobile shows throughout the country

Hupmobile Runabout—$750 F. O. B. Detroit, including top, wind shield, gas lamps and generator, three oil lamps, tools and horn. Four cylinders 20 H. P., sliding gears, Bosch magneto.

In the new Hupmobile plant, now nearing completion, which will have when finished a capacity of 15,000 to 20,000 cars a year, the Runabout—always a car of unprecedented popularity—will continue to occupy the same large part in our manufacturing plans that it does at present.

Hupmobile Coupe—Chassis same as Runabout—$1100 f. o. b. Detroit.

Hupmobile Roadster—Chassis same as World Touring Car—$850 f. o. b. Detroit.

A totally new idea of what you ought to get for $900

A new and larger Hupmobile which immediately thrusts upon your attention a score of *tangible superiorities* which set it in a class apart from cars of its price.

A five-passenger Touring Car for $900 which *rejects every characteristic of commonplace construction;* and makes clear its invasion of the field above that price; by points of difference and departure which no motorist can mistake.

Evolved out of the experience which has built thousands of the Hupmobile Runabout—the quality car today, as it always has been, of the runabout class.

Designed by E. A. Nelson, Chief Engineer of the Hupp Motor Car Company since its inception and designer of the original Hupmobile Runabout. To him and the skilled shop organization which he has continuously maintained, we owe the inimitable lines, the marked simplicity, the efficiency and the high quality of workmanship incorporated in the Runabout.

Impressed with the same strong individuality as the Runabout; and still further removed from comparison by:—

First, the small-bore, long-stroke motor. Second, the body design and construction which attains the purpose of the "underslung" and avoids all of its disadvantages; and Third, the Americanization, after close study abroad, of invaluable engineering principles entirely new to this country.

These highly specialized features speak so plainly of greater structural soundness; more progressive engineering principles; and costlier and more careful shop practice; that it is obvious, they proclaim a product without precedent at the price.

Small-bore, long-stroke motor—3¼x5½ inches—60% more pulling power for mountain work and heavy roads; 4 to 50 miles of speed; ability to pick up quickly without feeling the weight of the car, or throttle instantly to a walking gait.

Unit power plant.

Cylinders cast en bloc, with three bearing crankshaft (found only in other cars selling upward of $2500) instead of two. Bearings extra large, having bronze back, Babbit lined.

Valves enclosed by pressed steel cover, keeping oil in and dirt out—noiseless, minimum wear, minimum adjustment.

Thirteen-inch multiple disc clutch, action positive, smooth and easy.

Transmission gears of 40 H. P. size, run slowly and quietly.

Full floating rear axle, amply strong for a seven passenger car.

Aluminum crank and gear case; drawn steel used in parts where lightness and strength are requisite.

4½ x 8½ Photogravure Free

Write for detailed description and the 4½x8½ photogravure of the new touring car.

Hupp Motor Car Co., 1233 Jefferson Ave., Detroit, Mich.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AUTOMOBILES.

A NEW WHITE STEAMER, Model O-O, complete with top. Will sell at a very reasonable price. Address A. A. Hopkins, 963 St. Nicholas Ave., New York City.

AUTOMOBILES AND MOTORCYCLES.

AUTOMOBILES, $50.00 up; Motorcycles, $20.00 up; guaranteed for one year, shipped freight prepaid. Largest list and lowest prices in the world. King, Automobile Broker, Dept. S. A., 215 West 125th Street, New York City.

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A STRONG, old established, manufacturing company, with a national selling organization, wants to add a new line of building material or construction specialty to manufacture and sell. Address X, Box 773, New York.

FREE SAMPLE goes with the first letter. Something new. Every firm wants it. Orders from $1.00 to $100.00. Nice pleasant business. Big demand everywhere. Write for free sample. Metallic Mfg. Co., 438 N. Clark, Chicago.

GOLD DREDGING MINES very rich in Colombia. Mining Engineer wishes partner, will give liberal inducements, big profits, best of references. Address by mail only. S. Pickelmann, 109 West 54th Street, New York.

INVENTORS.—Send a copy of your patent to us and we will send you our contracts outlining our liberal manufacturing offer. For further particulars address, Atlantic Supply Co., Long Branch, N. J.

HELP WANTED.

LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Pres., The National Co-Operative Real Estate Company, L 378 Marden Building, Washington, D. C.

PATENTS FOR SALE.

BASIC PATENT No. 940,697 of a "Inner-Illuminated," two-light interchangeable-ad., Revolving Sign, for sale, outright, royalty or state rights. It's the most attractive and inexpensive sign invented. No competition, fully developed, and the market demands it. "Inventor," 208 Broadway, New York.

PROPOSALS.

PROPOSALS FOR BRICK DORMITORY, CENTRAL STEAM HEATING AND POWER PLANT. Department of the Interior, Office of Indian Affairs, Washington, D. C., November 15, 1911. Sealed proposals, plainly marked on the outside of the sealed envelope: "Proposals for Brick Dormitory, Central Steam Heating and Power Plant, for the Rapid City Indian School, South Dakota," and addressed to the Commissioner of Indian Affairs, Washington, D. C., will be received at the Indian Office until 2 o'clock, p. m., December 29, 1911, for furnishing materials and labor for the erection of a brick dormitory, central steam heating and power plant, at the Rapid City Indian School, South Dakota, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at this Office, the offices of the Supervisor of Construction, Denver, Colorado, the American Contractor, Chicago, Ill., Scientific American, New York City, the Improvement Bulletin, Minneapolis, Minn., the Journal, Rapid City, South Dakota, the Bee, Omaha, Nebr., the United States Indian Warehouses at Chicago, Ill., St. Louis, Mo., and Omaha, Nebr., the Builders and Traders Exchange at St. Paul, Minn. and at the school. For further information apply to the superintendent of the Rapid City Indian School, Rapid City, South Dakota. C. F. Hauke, Acting Commissioner.

REAL ESTATE.

TEXAS INVESTMENTS.—Buy farm orchard garden lands near Houston, the greatest and most prosperous city in the southwest, where values are going up all the time and fortunes made in real estate in short while. Easy terms if desired. Single crop pays for land; several crops annually. Address E. C. Robertson, 501 Kiam Bldg., Houston, Tex.

WANTED.

WANTED—Purchaser for Lilley's patent Bracket. Patented in five countries. A very low price will be accepted. For further particulars address, Bracket, Box 773, New York.

WANTED.—One chemist at $8.00 per diem; two first-class laboratorians at $5.04 per diem; two second-class laboratorians at $4.48 per diem; and two fourth-class laboratorians at $3.28 per diem. A competitive examination will be held January 5, 1912, at the Navy Yard, Washington, D. C., for filling the above positions at the Naval Proving Ground, Indian Head, Md. For further information address, "Commandant, Navy Yard, Washington, D. C."

MISCELLANEOUS.

RUPTURE. A new patented device worn in place of the ordinary truss. Simple, comfortable, and inexpensive. Endorsed by leading surgeons. For particulars, address, J. D. Howe, M. D., Tiffin, Ohio.

FREE TUITION BY MAIL.—Civil Service, Drawing, Engineering, Electric Wiring, Agricultural, Poultry, Normal, Academic, Bookkeeping, Shorthand Courses. Matriculation $5. Tuition free to first applicants. Apply to CARNEGIE COLLEGE, ROGERS, OHIO.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated. **MUNN & CO., Inc.**

Inquiry No. 9240.—Wanted, addresses of owners of limestone beds running not less than 98 per cent, and near a railway.

Inquiry No. 9241.—Wanted, addresses of owners of deposits of molders' sand suitable for heavy castings.

Inquiry No. 9242.—Wanted, addresses of makers of bag valves.

Inquiry No. 9243.—Wanted, address of maker of Rover's monogram embossers.

Inquiry No. 9244.—Wanted, address of manufacturers making rollers, scrapers, and driers suitable for mating soap leaves.

Inquiry No. 9254.—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

Inquiry No. 9255.—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be clean and fully proved.

Inquiry No. 9256. Wanted addresses of parties having Pitchblende deposits, if able to ship ore.

Inquiry No. 9257. Wanted addresses of firms selling second-hand water turbines.

Inquiry No. 9258.—Wanted addresses of parties having gem materials to offer in any part of the world.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Diesel Engine and the American Merchant Marine

To the Editor of SCIENTIFIC AMERICAN:

In a recent issue comment was made in your columns on the failure of the American inventor to keep pace with his European rival.

In the issue of October 7th, a very interesting article appears on the Diesel engine and its economy over the steam engine, especially when applied to ocean-going steamers.

One of the remarkable, as well as regrettable conditions, as far as our shipbuilders are concerned, is the indifference displayed to improvements in hull and motive power, particularly motive power, that have appeared in foreign-built tonnage in the past few years.

Foreign steamship builders are experimenting with the producer-gas engine, seeking to ascertain its economy as compared with the usual type of three-cylinder engine used generally in steamships; the oil-burning motor marine engine has been given a long test by foreign marine builders, and several steamers to be operated with gas engines are to engage in the trans-Atlantic trade this coming year, and possibly this fall will see one or more gas-driven ocean liners headed for our shores. These steamers that promise to run across this year will be passenger as well as freight.

Europe has no oil or fuel; it has to be imported, while the United States is the greatest producer of oil in the world, and yet our shipbuilders lag far and away behind the foreign steamship builder in applying the oil and gas engine to marine service.

It is fair to speculate on what causes the paralysis of the American shipbuilder, and one of the apparent causes is that it is shielded too much from competition.

The coasting trade—and by the coasting trade is meant every port in the United States and Alaska—from Eastport, Me., on the extreme northeast to farthest Alaska, in the northwest including Porto Rico, is called American coasting trade, and only American-built vessels can engage in the trade now; this gives a monopoly to the shipyards of the United States, and shielded from foreign competition the necessity for developing new and improved types of engines and steamers is not found necessary.

As to seeking to compete with the foreign builder in the steamship trade of the world, the American gave that up long ago; the only way that he can see, to get even the smallest footing in that trade, is for the government of the United States to pay him for making the attempt.

This attitude is the more surprising, as we make iron and steel far cheaper than can any other country in the world, while our exports of iron and steel the past year have been of tremendous volume and the competition of foreign nations in these articles is of no avail against the American manufacturer. It is also true that the report to the Stanley committee made by the United States Steel Corporation showed that it sold steel plates $8 to $11 per ton under the domestic prices.

That, evidently, is one reason why our shipbuilders cannot compete with the foreign builders; that condition can be remedied by putting steel and iron on the free list, and with these commodities free, independent yards would be started that would not be so conservative in applying the most modern development in marine engineering to ocean tonnage.

The Panama canal will be opened in a couple of years; already one American line is to bid on the contract offered by the Postmaster-General for a line between the American and Pacific ports of the United States, and already it is given out that the steamers this line will require to carry out the contract if secured will tax the capacity of our coast yards, when combined with the government work. Further government contracts must be considered only on a different price basis.

It is not difficult to see that, in a few years, trade on the Pacific will grow at a tremendous rate. Alaska has mineral stores that will keep a mighty fleet busy, to say nothing of the trade between Honolulu, Philippines and the United States. It is true that the Philippine carrying trade is not yet confined to American-built steamers, and it is lucky it isn't, for there is no American tonnage to-day that would engage in it except at prohibitive freight rates.

If ever there was a time propitious for the restoration of the American flag to the deep sea trade, it is now. The new development in marine engineering will make the vast foreign tonnage built up to the present time practically obsolete. As stated in your issue of October 7th the economy of the Diesel engine is so great, that no coal-burning steamer can compete with the motor-driven. And yet we have still to learn of any interest being taken in this new marine departure by any American shipbuilder. It was the same with the turbine engines. We followed far behind Europe, even in the experimental state.

We were far behind Europe in taking up the automobile and the airship. It is true that we came to the front with a rush, and we may do so in shipbuilding eventually. What our iron and steel industries need is, less coddling by the government; the stimulus of competition will enable us to achieve a place in the deep-sea carrying trade of the world that subsidies will never secure for us.

And again it becomes apparent that the tonic of free ships would be of immense benefit to our deep-sea foreign trade. A free ship bill now would allow our people to invest in these modern motor-driven ocean steamers and establish the American flag in the carrying trade of the world, and the old bugaboo of the American wage scale would be of little consequence in this type of steamers as the coal heavers would be a thing of the past.

Chicago, Ill. CHARLES DEPESEE.

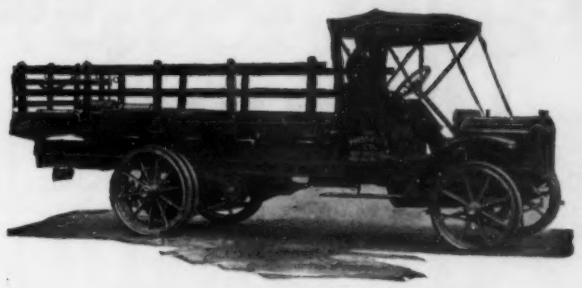
Nitrogen and the Soil

To the Editor of SCIENTIFIC AMERICAN:

I am in receipt of a copy of the letter of Drs. Lyon and Bizzell of Cornell University.

Their contention that they were the first to announce the fact that non-legumes may secure a supply of combined nitrogen from legumes (when the two are growing together) should be qualified. According to their own admission, their first article was received by the editor of the *Journal of Industrial and Engineering Chemistry* on April 21st, 1910, and appeared in July, 1910. The inclosed letter from Prof. A. D. Hall, Director of the Rothamsted Experiment Station, and editor of the *Journal of Agricultural Science*, will show you that my article was received by him in August or early September of 1909. Unfortunately, however, the issue of the number of the *Journal of Agricultural Science*, containing my article, was delayed for more than a year, and the article in question appeared in print, therefore, in 1910, instead of 1909. In this article of mine, I state distinctly that the non-legumes, separated by a porous wall from the legumes, were able to obtain very considerable quantities of combined nitrogen. Furthermore, the photographs show distinctly the benefit derived from the association. I did not submit analyses, even though those had been made, since I did not regard it necessary to submit figures in a preliminary publication. Furthermore, the bulletin published by Drs. Lyon and Bizzell, and entitled "A Heretofore Unnoted Benefit from the Growth of Legumes" is dated March, 1911. In other words, this was submitted to the printer several months after my article in the *Journal of Agricultural Science* appeared in print. According to the admission of Drs. Lyon and Bizzell, the number of the *Journal* containing this article was received at the Cornell University Library in October, 1910. Hence, they were not justified in designating their bulletin as they did by the title given above.

It will be shown by the writer (in his



What Motor Trucks Mean

IF you are not using motor trucks, we take it for granted that you do not understand the benefits to be derived from them. Possibly you have the wrong viewpoint—perhaps you have been making too many comparisons with the horses and not really investigating what the truck meant to you as a machine to perform certain work. The individual or firm that has a better delivery system has an advantage—the kind of business doesn't matter—service is appreciated universally. If The White Company can place in your hands a more efficient means of making deliveries, they have given you an opportunity of extending your field—of broadening the horizon of your product—of making good—where you had been unable to go before.

White Trucks Known for Performance

GO into any large city in the United States—ask the men who have the largest delivery problems, to see what they know about these White trucks. Almost regardless of whether they own them or not, you will find that they know their record for splendid performance. To the man about to invest in trucks, a list of White owners will appeal as almost a directory of the big business men. They have invested their good money in White trucks and their endorsement is the fact that they are continually increasing their equipment. No one buys and buys again the thing that fails to stand the test. We could tell you why—because it is all in the designing—in the building—in the care we take in the production of the truck. The important thing to you is that they do perform—that White trucks satisfy their owners—and, therefore, must be the kind that you want.

1500-lb. delivery wagons, 1½-ton, 3-ton and 5-ton trucks—all with a universal type of power plant.

Let us submit a solution of your delivery problem. It will entail no obligation

The White Company

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We offer to all poultry raisers the essential knowledge and secret methods of many of the most successful poultrymen of America. As a rule these secrets have been guarded with extreme care, for it is on them that the great successes have been built. They have cost years of labor and thousands of dollars. They will cost YOU only a trifle and a few minutes to write us.

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Michael K. Boyer, Associate Editor American Poultry Advocate, has had exceptional opportunities and the closest friendship with poultrymen all over the country. They have freely told him many of their most jealously treasured secrets, many others we have bought, and this scattered material, together with several of Mr Boyer's own valued methods, has now been collected in book form. It must be clearly understood that **every secret printed has been obtained in an honorable way.**

"Poultry Secrets"

First published in 1908, this collection of the carefully guarded secrets of famous poultrymen created a sensation in poultry circles. It has run through thirteen editions, and is still selling at a lively rate.

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SECRETS OF FOWL BREEDING – Burnham's Secret of Breeding. Felch's Mating Secret. Mendel's Secret of Heredity. Secret of Alternating Males for Fertility. The Grundy Method. Curtiss' Secret of Hatching More Pullets than Cockerels. Davis' Secret of Raising Every Chick. Babcock's Secret of Developing the Spike on a Rose Combed Fowl.

SECRETS OF FEEDING. Secret of Feeding Grains. Dr. Woods' Laying Food Secret. Feeding Linseed Meal. Feeding Meat and Salt. Proctor's Salt Secret. Brackenbury's Secret of Scalded Oats. Feeding Charcoal, Grit and Oyster Shells. Secret of Green Feed. Secret of Feed at Fifteen Cents per Bushel. Sprouted Barley Secret. Smith's Secret of Preserving Vegetation in Poultry Runs. Important Feeding Secret. Miscellaneous Feed Pointers. Chick Feed Secrets. Seely's Secret of Dry Bran Feeding. Gowell's Fattening Secret. Gray's Fattening Secret. Greiner's Corn Feeding Secrets. McGrew's Secret of Feeding During Moulting.

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READ WHAT PURCHASERS SAY

I received Farm Journal and "Poultry Secrets," and am very much pleased with both. The secrets are worth their weight in gold. Why, I paid $5.00 for the sprouted oat method. You certainly give a fellow over his money's worth. Andrew F. G. Morey, Utica, N. Y.

I purchased a copy of "Poultry Secrets," and find many helpful ideas in it, especially Dr. Wood's Egg Hatching Secret.
Mrs. F. T. Darnell, Westfield, Ind.

By putting within our reach these "Poultry Secrets," you are doing a more philanthropic work than giving alms or endowing hospitals, for you make it possible for us to make both ends meet.
L. Boyce,
Milwaukee, Wis.

Received your book of "Poultry Secrets." It's an exceptionally instructive work, and worth $10 to any progressive poultryman. I would not care to take that for my copy if I could not get another.
Robt. F. Kingsland,
Montville, N. J.

The Farm Journal came to hand, and later "Poultry Secrets," also arrived, all of which I was very glad to receive and have been greatly interested in reading same, and think you are doing a glorious work in diffusing such valuable knowledge for so little money.
F. B. Meade,
Boston, Mass.

As to "Poultry Secrets," I will say, I have lectured on this subject over the greater portion of this state for the past fifteen years, and have about every book that is published on this subject in my library and I consider this book of yours the most valuable I know, by far, for the general public.
L. A. Richardson,
Marine, Ill.

Is this cock properly held? "Poultry Secrets" tells you how to carry fowls, and scores of secrets far more important and hitherto unrevealed.

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Profusely illustrated, with many fine drawings and diagrams. 64 pages

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The **FARM JOURNAL** is the standard paper for everyone who lives in or near the country, or ever has, or ever expects to. A particularly fine poultry department, more valuable than most poultry papers. 33 years old, 750,000 subscribers and more. Goes everywhere. Clean, clever, cheerful, amusing, intensely practical. Cut to fit everybody, young or old, village, suburbs, or rural routes. Unlike any other paper and always has been.

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forthcoming bulletin) that the beneficial effect of legumes or non-legumes, was noted and recorded many years ago; in fact, empirical observations on this subject were recorded more than one hundred years ago in English books on agriculture. Hence, the writer does not claim that he was the first to observe this effect. Nor are Lyon and Bizzell justified in making this claim for themselves. It is the contention of the writer that he was the first to demonstrate in an exact and scientific way (by properly controlled pot experiments) that diffusion of nitrogen compounds, out of the roots of legumes takes place, and that these nitrogen compounds may diffuse through sandy soil and through porous earthenware, and may be absorbed by non-legumes separated from the legumes in this manner.

JACOB G. LIPMAN, Director.

New Jersey Agricultural College Experiment Station, New Brunswick, N. J.

Wooden Shoes

To the Editor of SCIENTIFIC AMERICAN:

In your issue of October 28th, 1911, under the caption of "Wooden Shoes," the United States Vice-Consul at Amsterdam, Holland, is made to say that Lancaster County, Nebraska, is a large importer of wooden shoes from Holland. For the benefit of your readers, and particularly the enlightenment of the Honorable Vice-Consul, we would like to have it understood that Nebraska is thoroughly civilized and we have the lowest percentage of illiterates of any State in the Union. The United States Custom House was opened in Lincoln twenty years ago, and a search of the records of importations fails to disclose a single shipment of wooden shoes for any firm in the State.

You might be interested in knowing that the largest wooden (shoe) sole factory in this country is located at Columbus, Nebraska, sixty miles north of Lincoln, and that the entire output is consumed in the territory lying east of Ohio and north of the Potomac River.

W. S. WHITTEN,
Secretary Lincoln Commercial Club.
Lincoln, Neb.

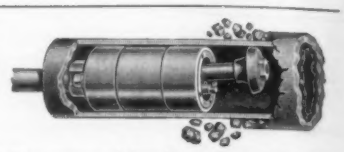
Lieut. Rambaldo—The End of a Promising Career

SOME months ago the SCIENTIFIC AMERICAN mentioned the daring project, conceived by Lieut. A. E. Rambaldo, of the Dutch navy, of exploring the interior of New Guinea by drifting over it in a balloon. This plan found many warm supporters in Germany, where it was chiefly promoted, but had at length to be given up, as the necessary funds were not forthcoming.

Recently news has been received that Rambaldo met an untimely death in Java on August 5th, while making a balloon voyage, in company with Lieut. van Steyn, also of the Dutch navy, from Soerabaia in the direction of Semarang. In attempting to make a landing in a forest, Rambaldo had climbed into the upper branches of a tree; a sudden upward movement of the balloon pitched him to the ground, while his companion was carried away in the lightened balloon. His lifeless body was recovered the following day. Van Steyn effected a safe landing.

Rambaldo, who was not yet thirty-two years old at the time of his death, was an aeronaut of the type that is commoner in Germany than elsewhere. He was a keen student of the new science of aerology, and spent many months in studying the methods of upper-air research at Lindenberg Observatory and at other aerological stations. Subsequently he made a long and valuable series of kite observations during a cruise to the West and East Indies on board the Dutch man-of-war "De Ruyter." Having been ordered to duty in Java, he founded an aeronautical society in that colony, and took an active part in inaugurating the aerological work of the Batavia Observatory, the brilliant results of which during the last few months have added much to our knowledge of the upper atmosphere.

At the time of his death he was planning to return to Europe to take a course in aviation, and had recently published in the German aeronautical press the outline of a project for introducing this art on an extensive scale in Java, for scientific and practical purposes.



The Dean removing scale from the tube of a return tubular boiler

SCALE

plays havoc with a boiler and digs deep into the coal pile.

And you *can't* prevent scale from forming by the use of chemicals.

You must *remove* it by a mechanical cleaner.

The Dean Boiler Tube Cleaner

Is used by over 12,000 concerns to fight scale.
It cleans fire tube or water tube boilers.
It is operated by air or steam and cleans 10 to 30 tubes an hour.

Suppose you write for our booklet "Scale Removal Made Easy," which tells just how the DEAN does its work and how it can save you money.

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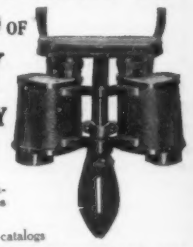

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(12572) S. B. asks: If a meter were attached to the wire of a five-horse motor, and the current (500 volts) turned on for, say, one hour, running only single motor, would it use as much juice in one hour as if the motor were doing full five horses' work? A. If a five horse-power electric motor is run without load, it will only require the current to turn it which is able to overcome the friction of the parts of the motor. If full load is put upon the motor, it will then require five horse-power to turn it. This is exactly the same as any other machine, a grindstone, for instance. A boy can turn it swiftly when there is nothing grinding upon it; but if a man holds a scythe upon it, bearing down with all his force, even a man might not be able to keep the stone in motion. Power must be furnished to any machine in proportion to the work called for from the machine.

(12573) G. W. M. asks: 1. What are the chemical elements found in the atmosphere? Is there any chemical change when subjected to heat? A. Atmospheric air is made up of 21 per cent of oxygen, 78 per cent of nitrogen, about 1 per cent of argon, and a minute trace of helium, xenon, neon, krypton, hydrogen. No chemical change is produced by simply heating the air to any moderate degree, unless some other substance is present which can be burned with the oxygen. At the temperature of the electric arc the nitrogen and oxygen combine and form nitric and nitrous oxides. 2. How is commercial oxygen, used in medical science, produced? A. Oxygen for industrial and medical purposes is made from chlorate of potash or from binoxide of sodium. The former is heated in a retort with manganese dioxide, and the latter is simply dropped into water.

(12574) E. J. L. asks: Will it be too much bother to advise me the number of cubic feet in a perch of stone? The dictionary and printed authorities all seem to agree on 24¾, but masons here claim that there are only 16½. A. A "perch" of masonry is not a measure whose value is everywhere the same. It seems to be usually 16½ feet long and 1½ by 1 foot, which would make it contain 24¾ cubic feet. It is often taken at 25 cubic feet, but has other values in different places. If all such peculiar measures could be dropped and our work measured in feet, yards, etc., it would greatly simplify matters.

(12575) J. B. C. asks how to oxidize silver. A. 1. Add four or five thousandths ammonium sulphide or potassium sulphide to water at a temperature of 160 to 180 degrees Fahrenheit. When the articles are dipped into this solution an iridescent coating of silver sulphide is produced, which, after a few seconds, turns blue black if allowed to remain in the liquid. Remove, rinse, scratch-brush, and burnish when desired. 2. There are two distinct shades in use, one produced by a chloride, which has a brownish tint, and the other by sulphur, which has a bluish-black tint. To produce the former it is only necessary to wash the article with a solution of sal ammoniac (ammonium chloride). 3. A much more beautiful tint may be obtained by employing a solution composed of equal parts of copper sulphate and ammonium chloride in vinegar (or dilute acetic acid). The fine black tint may be produced by a slightly warm solution of sodium or potassium sulphide. 4. Bromine, 5 gr.; potassium bromide, 5 dwt.; water, 10 oz.; boil the silver in this usually 2 to 5 minutes, then polish with rouge. 5. Dissolve sulphate of copper, 2 dwt.; nitrate of potash, 1 dwt.; ammonium chloride, 2 dwt., in a little acetic acid. Warm the article and apply the solution with a camel's hair pencil and expose to the fumes of sulphur in a closed box. Parts not to be colored must be coated with wax. 6. Dip the clean silver article in a solution of sulphide of potassium (liver of sulphur), 2 dr. to 1 pt. of water. Heat this solution to a temperature of 175 degrees Fahrenheit. Immerse for a few seconds only, when the article becomes blue black. For a velvet black, dip the article, previous to oxidizing, in a solution of mercurous nitrate and water, and rinse. Then dip in the sulphide solution as above. For a brown shade, oxidize the potassium sulphide as above, then dip in a liquid composed of 10 parts of blue vitriol and 5 parts of sal ammoniac to 100 parts of vinegar. After oxidation, brush with a scratch brush very lightly, to brighten and variegate the surface. There are many other methods, among which will be found the following: 7. Expose to the vapor of chlorine. 8. Use a solution of equal parts of copper sulphate and ammonium chloride dissolved in vinegar.

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THE UNITED STATES NAVY. A Handbook. By Henry Williams, Naval Constructor U. S. Navy. New York: Henry Holt & Co., 1911. 228 pp. Illustrated with numerous half-tone engravings and line cuts. Price, $1.50.

A naval constructor, above all men, is furnished for the task of telling the layman just the very things he wishes to know about the United States Navy. For not only is he absolutely familiar with the construction of the ships, from keel to fire-control platform; but, due to his having spent several years at sea in perfecting himself for his profession, he is thoroughly acquainted with the operation of these ships at sea, and the routine life of the officers and men both ashore and afloat. The author was prompted to write his book after answering many of the letters which came to the Department requesting information regarding the Navy. The work is intended primarily for the information of persons having some interest in naval affairs—and Mr. Williams has succeeded in writing a book which does this without being too technical. The Handbook is written also with a view to supplying newspaper men with the information they so frequently apply for. Furthermore, the writer has had in view the desire of the friends of enlisted men from the interior States for information regarding the ships and the service. The work has been well done. It opens with a brief history of the Navy. Then follow chapters on The Navy's Organization; The Navy's Personnel; The Man-of-War in Commission; The Different Classes of Ships; A Description of the Equipment, etc., of Our Ships; High Explosives, under which are treated mines, torpedoes, and aeroplanes; The Designing and Building of a Warship and the Drydock. The work closes with a chapter on "The National Defense," in which the paramount importance of an adequate navy is clearly proved. We give this work our hearty commendation.

THE CORSICAN. A Diary of Napoleon's Life in His Own Words. By R. M. Johnston. Boston and New York: Houghton, Mifflin & Co. 526 pp. Price, $1.75.

This book is to be welcomed as a distinct and valuable addition to the already enormous mass of biographical literature which deals with the life and character of Napoleon I. In the endeavor to get a true perspective of that most extraordinary man of the eighteenth and nineteenth centuries, the historian and biographical writer have tried many points of view. Perhaps, after all, the most effective method of putting one in touch with Napoleon is to let him speak for himself, and this Mr. Johnston has done by presenting the diary of Napoleon's life, written in his own words. A perusal of this work puts us in very intimate touch with the man himself; and one lays it down with the conviction that not the least among the qualifications of this exceedingly versatile genius was his ability to speak and write tersely and with a great power of illumination. Commencing with his earliest days in the military schools, these extracts, judiciously chosen from his diaries, correspondence, private and political, and proclamations to the army and the people, give a view of Napoleon quite devoid of distortion, which is inseparable from a partisan biography. Perhaps the most marked impression left by this book is that of the intense humanity (as distinguished from the all-but-total lack of humaneness) of the great soldier. He had his full share of the vanity and pettiness of human nature. Never, until reading this work, did we appreciate how largely Napoleon's success was due to the fact that he was an engineer. It was the practical and constructive in the man that won him lasting honor as the promoter of great public works, and carried him like a thunderbolt through the best armies of Europe.

NAVAL STRATEGY. Compared and Contrasted With the Principles and Practice of Military Operations on Land. Lectures delivered at United States War College, Newport, R. I., between the years 1887 and 1911. By Rear-Admiral A. T. Mahan, D.C.L., LL.D., United States Navy; author of "The Influence of Sea Power Upon History, 1660-1783," "The Influence of Sea Power Upon the French Revolution and Empire," "The Life of Nelson, the Embodiment of the Sea Power of Great Britain," etc. Boston: Little, Brown & Co., 1911. 475 pp.; 8vo. Maps and plans. Price, $3.50.

The author of this work needs no introduction. Always well known in the U. S. Navy as an able lecturer on naval strategy, he was but little known abroad until the appearance of his great work, "The Influence of Sea Power upon History," which brought him international repute. At once he was recognized abroad, and particularly in Great Britain, as the foremost authority on the great question of the importance of the command of the sea as the deciding factor in the struggles of the nations for supremacy.

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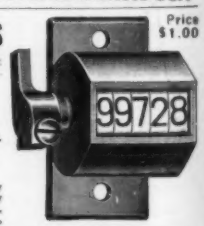

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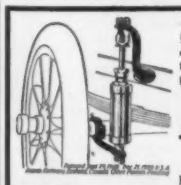

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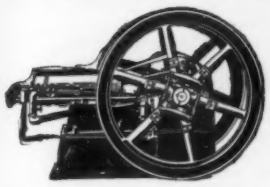

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COST-KEEPING FOR MANUFACTURING PLANTS. By Sterling H. Bunnell, Ph.B., M.E. New York: D. Appleton & Co., 1911. 8vo.; 233 pp. Price, $3 net.

To reach its highest efficiency a manufacturing plant must be watched as a doctor watches a patient. It is the cost-keeping department that must point out the weak spots and indicate a remedy. Without accurate knowledge of weak spots—that is, of instances where the cost of operations exceeds or approximates the selling price—remedies are mere guess-work. On the other hand, there is so much of complication and red tape about many cost-keeping systems that manufacturers hesitate to adopt them. Mr. Bunnell, while avoiding in great measure the encumbrances incident to these systems, sacrifices nothing of efficiency. He surveys the field of cost-accounting in a general way, gives some valuable counsel on the introduction of an adequate system, and then proceeds to sustain and amplify the general principles by reducing them to practical application. All the necessary accounting forms are drawn and their uses explained, so that the routine of cost-keeping may be established with the least amount of labor and worry, and may result in accurate and progressive knowledge of vital facts and details. He clearly demonstrates that the efficiency of this department and the prosperity of a business are very closely related. It would be hard to find a more enlightening or sensibly-written work on the subject.

MOEDEBECK'S TASCHENBUCH FUR FLUGTECHNIKER UND LUFTSCHIFFER. Berlin: Verlag von M. Krayn, 1911. 920 p.; 238 illustrations.

It was in 1895 that the late Capt. Moedebeck issued his admirable aeronautic handbook. When we consider that the dirigible at that time had hardly developed much beyond the experiments of Renard, and that Lilienthal alone had made any experiments in dynamic flight, we can readily understand how bold an undertaking Moedebeck's was. Yet he carried through his scheme with good judgment and with such foresight that his book proved a boon when the dirigible really took its place in our daily lives. In the first edition it was almost out of the question to devote much space to the flying machine for the simple reason that the flying machine as we know it did not exist. In the second edition, issued in 1903, the remarkable performances of the dirigible still took up the major portion of the book. Unfortunately Capt. Moedebeck was not spared to revise this last edition. That task has been intrusted to Prof. Suering, of the Royal Meteorological Observatory at Potsdam. That he has done it ably follows almost as a matter of course from his scientific standing. As it now comes to us, the book is divided into the following chapters: Gas (The Physical Properties of Gases and Technology of Gases); Atmospheric Physics; Aerological Observations; Kites and Parachutes; Balloon Technics; Navigating a Balloon; The Basis of Balloon Navigation; Practical Aspects of Balloon Navigation; The History of the Airship; Airship Construction, Practical and Theoretical; Navigation of Air Vehicles; Animal Flight; Gliding Flight; Technics of Flying; Engines for Airships and Flying Machines; Aerial Propellers; Society News; Tables.

ARTISTIC HOMES. By Mabel Tuke Priestman. New York: A. C. McClurg & Co., 1911. 8vo.; 148 pp.; illustrated. Price, $2 net.

There is a steadily increasing appreciation of sensibly-planned and at the same time artistically satisfying houses that is encouraging to those of us who would have America surpass her older rivals in modes of taste as well as in business methods. A home that is pleasing and restful to the eye contributes substantially to the contentment and education of mankind, and costs no more in the long run than many of the pinnacled and castellated atrocities we see around us. The growth of this appreciation of the truly beautiful and useful in home-making has been fostered to no small degree by such works as Mrs. Priest's "Artistic Homes," in which are described and pictured ideal dwellings visited by her in this country and in England, with concise statements of their cost and all the essential details of their construction.

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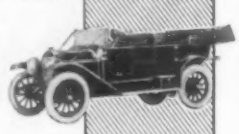

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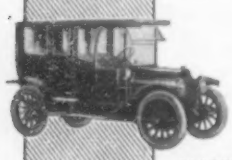

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Huge Icebergs of the Southern Ocean

THE September *Monthly Meteorological Chart of the Indian Ocean*, published by the British Meteorological Office, contains a most useful account of the icebergs of the Southern Ocean, as reported by ships of all nationalities during the twenty years 1891-1910.

In the southern hemisphere icebergs attain dimensions far exceeding that attained by similar formations in the northern hemisphere. They may be fallen in with anywhere poleward of the parallel 30 deg. S. As many as 4,500 different bergs have been actually counted in a run of 2,000 miles; estimated heights of from 800 to 1,700 feet are not uncommon; and instances of bergs having lengths ranging from 6 to 82 miles are numerous.

The most northern ice of the Southern Ocean, so far as the records from the beginning of the nineteenth century show, was a fragment of a berg sighted by the barque "Dochra" in 26 deg. S., 26 deg. W., in April, 1894. Icebergs are seldom sighted on the regular trade routes south of Australia, between the west coast of South America and the meridian of 80 deg. W., and between the Falkland Islands and the east coast of South America.

As to the abundance of icebergs in certain years, besides the case above mentioned of 4,500 bergs seen in one voyage, several other remarkable records are cited. Thus in March, 1910, the "Prima" passed between 2,000 and 3,000 icebergs in two days, while steaming from 54 deg. S. 36 deg. W. to 47 deg. S. 38 deg. W.

The many flotillas of icebergs passed by vessels during the prolific period 1892 to 1897 included some of the loftiest on record. In January, 1893, when 400 miles east of the Falklands, the "Loch Torridon" passed many bergs varying in estimated height from 500 to 1,000 feet, and one of 1,500 feet. The "Charles Racine" sighted a berg 1,500 feet high, midway of the Cape and Australia, in December, 1896; and one of the same height was sighted from the "Zinita," in November, 1904, about 120 miles south of the spot where that of the "Loch Torridon" was observed. The loftiest berg on record, which had an estimated height of 1,700 feet above sea-level, was passed by the bark "Emil Julius" in June, 1884, when in 44 deg. S. 49 deg. E. Since the beginning of 1889 there have been reported 39 instances of bergs from 800 to 1,700 feet in height; and 16 of these had an altitude of 1,000 feet. So far back as 1840 a berg 1,000 feet high was sighted not far from the Cape of Good Hope.

Since the beginning of 1884, 42 ships have reported bergs having estimated lengths of from 6 to 82 miles. In May, 1892, the "Strathdon," in 44 deg. S. 30 deg. W., sailed 40 miles along the side of a berg. This ice-island was 1,000 feet high. In January, 1893, the "Loch Torridon," in 50 deg. S. 45 deg. W., by sailing along the side of a berg determined its length to be 50 miles; and two months later, about 200 miles farther west, the bark "Æthelbert" is said to have passed one which was 82 miles long! Some of the extreme lengths reported in good faith are, however, perhaps based on optical illusion; as a berg is sometimes unwittingly viewed through a gap between two other huge bergs, situated on either side of it, and overlapping its ends. A case of this kind was observed during the "Challenger" expedition.

A cubical iceberg will float with about one-ninth of its total height above the water. It is not difficult, however, to imagine a lofty pinnacle berg having its base spread over a large area, and the under-water depth comparatively insignificant. In the majority of bergs the vertical heights of the submerged and visible portions seldom vary directly as the corresponding volumes.

Throughout the five months ended April, 1855, a book-shaped ice-island drifted about between the parallels of 40 deg. S. and 44 deg. S. and the meridians of 20 deg. W. and 28 deg. W. The longer side stretched 60 miles, and the shorter parallel side 40 miles. Between the two was a bay quite 40 miles from side to side at its widest part. Several ships entered this *cul-de-sac* under the erroneous supposition that there was an exit; and one was lost with passengers and crew. In 1892 and 1893 the "Cromdale," "Was-

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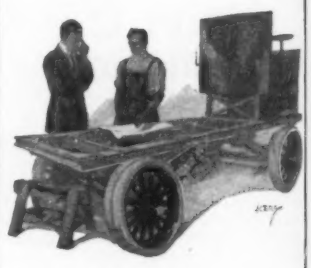
SCIENTIFIC AMERICAN

Annual Motor Number



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JANUARY MAGAZINE NUMBER
of the SCIENTIFIC AMERICAN
Issue of JANUARY 6th, 1912

In what respect do leading types of motor trucks for 1912 differ mechanically? How can the owner best protect his investment in motor trucks? What is the cost of operation as compared with horse-drawn trucks? Can truck chauffeurs be made of ordinary teamsters? These are vital questions to the intending purchaser of motor trucks, which are ably discussed in an article entitled **"Selection of a Motor Truck."**

The pleasure vehicle has now become so standardized that the **Riding Qualities of an Automobile** (the subject of an another article) now receive more thought than heretofore. The springs, the upholstering, the balance and hang of the body, all enter into the making up of a comfortable car. Other matters now of paramount importance to the motorist are the **Abolition of the Starting Crank, Lighting Systems,** which make automobiling at night safe and pleasurable, and the efforts to solve the **Tire Problem.** These form the subject of three special articles.

The **Comparative Cost of Light and Heavy Cars** is debated by a man who has made a painstaking comparison of every detail of his personal expenses in connection with the two types of cars.

The various phases of the automobile industry are discussed.

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dale," and "Ranee" had a like experience. At daybreak one morning the "Wasdale," northeast of the Falklands, was discovered to be in a bay, of horseshoe shape, hollowed out of the side of an ice-island. This bay was 20 miles long. It varied in width from 10 miles at its broadest part to 4 miles at the entrance, and swarmed with large loose bergs.

Recent Views on Road-Tarring

By Dr. Guglielminetti

SINCE the author made the first tests as to the tarring of macadamized and other roads about ten years ago, the question has been taken up in France by the Dust Prevention League, and the results were discussed at the International Congress of Roads held at Paris in 1908 and at the Brussels Congress of 1910. Since that time, it may be said that surface tarring has entered into standard practice. As regards the question of hygiene, it appears that the desired end has already been reached, inasmuch as the amount of dust is much lessened. The other point to be considered is that of cost. All road engineers are agreed that tarring has the effect of lessening the wear of roads and increasing the life of the pavement, to say nothing of the reduction in street-cleaning expenses, including watering, mud removal, and sweeping.

But it was somewhat difficult up to the present to give any good figures for the economy realized on any given road. In fact, it requires a certain time to estimate the economic results as to upkeep of a road where the nature and amount of traffic vary considerably from one year to another. At present we are able to give some figures relating to the Avenue du Bois de Boulogne, a wide avenue leading out to the large park of the same name. The figures are given by M. Bret, one of the city engineers. This avenue is one of the finest in Europe, measuring 0.93 mile in length and 53 feet in width, and being bordered by a riding track and a footway. The total surface is 25,466 square yards. It was newly macadamized in September, 1906, and was first tarred in May, 1907. Since then it has not been macadamized; before the tarring was adopted it had to be re-laid every three years. The figures for expenses were drawn up for three and one-half years preceding the tarring, then for four years afterwards. Comparison of the figures shows that the annual saving up to the present is 11 cents per square yard, or about 25 per cent on the re-laying and upkeep expenses alone, not counting the economy on cleaning expenses. It is noticed that the road was tarred only once in 1907, and after 1908 it was tarred twice a year, in spring and autumn. The author, who is a leading official of the league, arranged with the city engineers so as to have tarring done in autumn in order to have a fresh surface for the winter traffic. The result was striking, and in the spring following it was found that the surface was still in a very good state and the tar had remained on the greater part of the road surface, except in the middle where it had commenced to wear off.

The economic question involved appears to be settled, and the life of the road may be considered as doubled, so that the tarring expenses are more than made up by the increased wear, as above shown. On the other hand, the frequent relaying of ordinary roads, which requires two months, causes great disturbance in the traffic, while the tarring process needs but a few days in order to allow the tar to dry.

As regards the efficiency of the process in laying dust, the results are remarkable. Before this, the avenue in question had to be frequently sprinkled in the hot season every two or three hours, but one washing per day is all that is now required, and no one complains of the dust. Many thousands of automobiles per day pass over the avenue, so that at certain times, it used to be almost impossible to carry out the sprinkling; hence arose great clouds of dust and much discomfort and spoiling of clothes. At present this has disappeared, and all agree as to the benefits of the tarring process.

It would be too much to say that tarring could be carried out with equal advantage on all kinds of macadamized roads, for in the present case the traffic,

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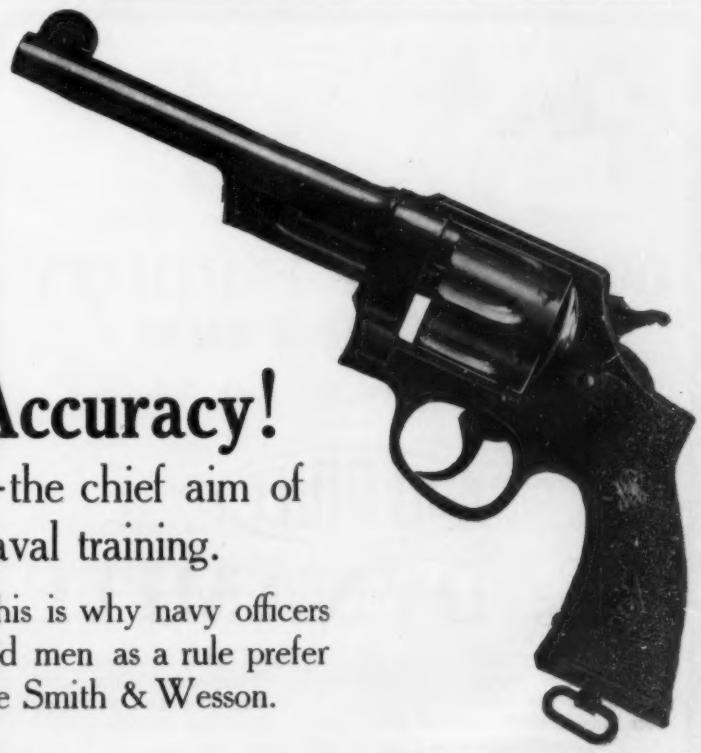

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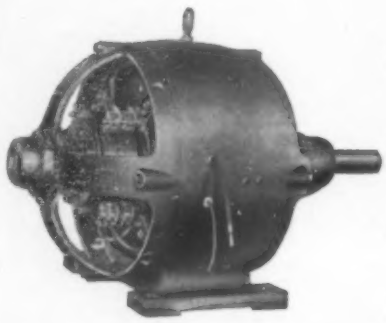

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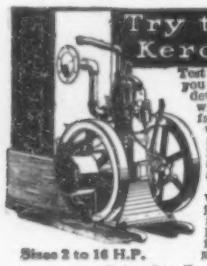

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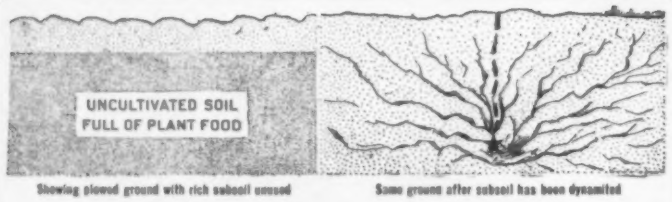

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though dense, consists exclusively of light private vehicles, as the road is closed to heavy conveyances. In considering the question we must see what roads are best adapted to the tarring process. The failure properly to take into account this factor may explain the want of harmony between the city engineers having charge of streets and the engineers occupied with country roads, which was noticed at the Brussels Congress. The city engineers favored the suppression of macadamized roads in cities and considered that such should be paved with stone, wood, or asphalt as traffic increases. Opposed to this opinion were the other road engineers of nearly all the nations represented, and they showed the good results which road tarring had given, claiming that in towns having a lighter traffic this could be used to advantage. To conclude, a judicious choice should be made, and the tarring should not be done on macadamized roads where the heavy traffic required a re-laying every two years or even once a year. Such roads should certainly be paved, reserving the tarring for other kinds of ways.

The question, however, has been raised as to whether tarred roads have not a bad effect on the eyes of drivers and also upon trees and plants which border the routes. As to the harm done to the eyes, proof appears to be wanting, as the road from Paris to Versailles is entirely tarred, as well as the above-mentioned avenue, and we hear of no serious complaints for eight or nine years past, nor upon the roads in the south of France around Nice, where the dust is much greater. Laboratory experiments as to the effect of such dust on animals' eyes are of no avail, as any kind of dust is of course bad for the eyes.

Opinions are divided as to trees and flowers. Plant-growers claim that dust and tar-vapors cause harm, while engineers think this is exaggerated. At Paris, the opinion is in favor of the tarring, in spite of any slight harm that may be done, owing to its other advantages. Dr. Griffon, in a paper read before the Academy, speaks first of tar vapors and then of dust. Vapor is bad for plant cells in laboratory tests, but this is not conclusive, as in reality such vapor must be very weak. He noticed that after the spreading and during the hardening of the yet unused roads, no effect was seen on the plants. As to dust, this has some effect on weak plants such as the begonia and others, which is not given from ordinary roads, but trees and shrubbery, also most plants and flowers, appear to show no harm. Leaves of trees may become brown or withered, but this often occurs in city streets, and is due to other causes. On the whole, his extensive inquiries in France and England lead him to favor the tarring.

No complaint apears to be heard in other countries. Since 1910, over 10,000 miles of road has been tarred in England, and the review *The Surveyor* does not note any serious injury to the eyes nor to plants. In Germany the same opinion appears to prevail, as also in Belgium. Owners of villas and gardens in the Riviera are among the most prominent members of the league, showing that they still favor the tarring. One reason for this latter opinion is that the plants in the south are of stronger growth, which leads to the opinion that the plants on Paris avenues should be changed. To bring out the question, the Prefect of the Seine department lately appointed a commission of leading experts. Shrubbery and various plants will be set out along tarred and untarred routes to compare results, and laboratory tests will be made upon any spots occurring in leaves. Attempts are made to purify tar and some samples are now produced which are much less harmful to plants and come near to Norway tar, which is quite inoffensive. It remains to be seen whether this will be economical or not. In any case, it seems evident that it is better to change the plants than to abandon the tarring, owing to its disadvantages. Dust also needs to be suppressed as much as possible. Even while no dust comes from the wear of the road itself, such is brought from the outside by wind or vehicles. The road should therefore be properly watered, and the author proposes to use one of the recent oil products which mix with the water, such as

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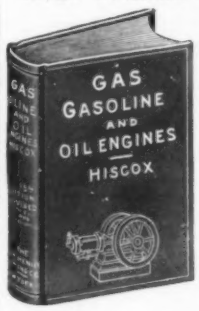

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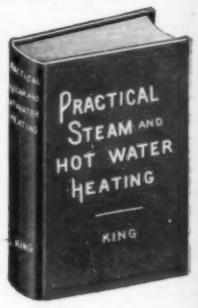

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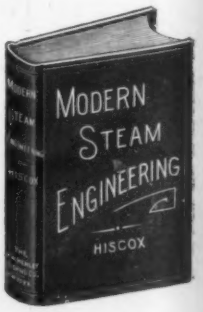

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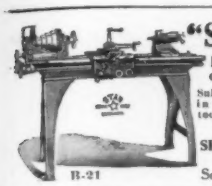

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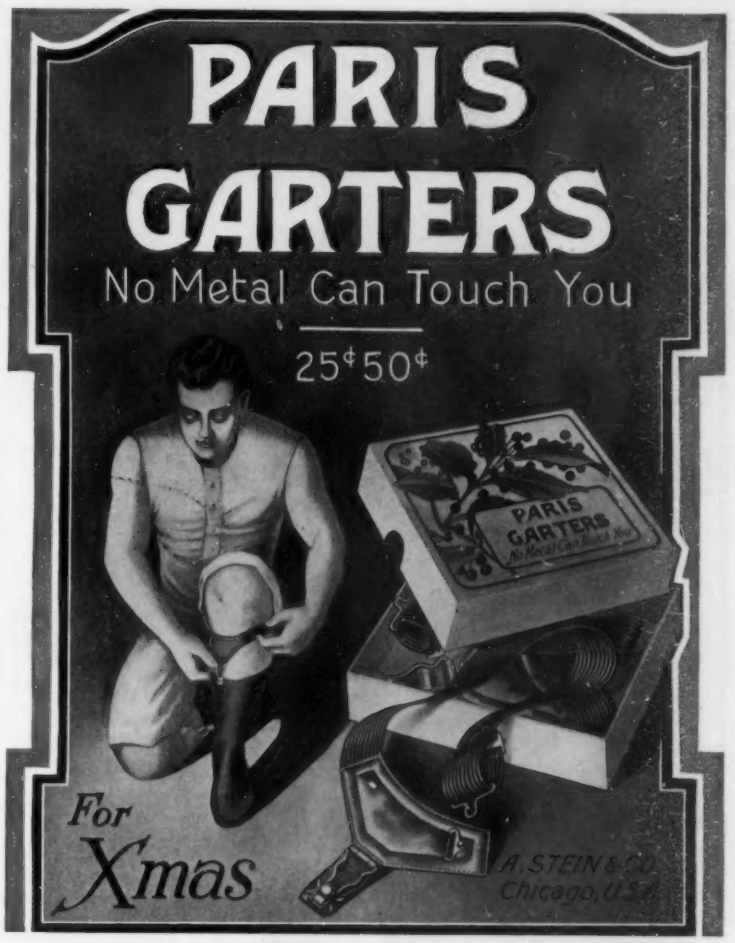
"Westrumite," and this will aid in keeping down the dust.

The Crusade Against the House Fly

ON July 24th, there was instituted in Washington, a most interesting crusade against the common house fly. For several seasons one of the leading daily newspapers of the capital has been printing in display type the legend SWAT THE FLY, but this summer this same paper began its campaign in earnest. Realizing that it is human nature to desire a pecuniary incentive for any public service, several hundred dollars in prizes were offered, one hundred dollars being the grand prize for the greatest number of flies killed, and many other prizes of lesser amounts representing first, second, third and fourth prizes, etc. Only children under the age of sixteen were permitted to enter the fly-swatting contest. Each contestant is furnished with a fly swatter, and paper boxes for the dead flies were distributed. Each day the boxes containing the offerings of the workers are collected and the flies so exterminated are first counted at the Health Office, and then cremated. The first five days of the campaign saw the leader in the contest with the proud record of 40,000 flies killed, with a long list of those who had more than 20,000 to their credit. It is interesting to note that the children have organized themselves into squads and range over several blocks of territory, killing the flies in kitchens, grocery stores, stables and refuse heaps. Even out of doors the fly has no peace, but is kept busy dodging this veritable army of determined swatters. Up to date, by actual count, more than 2,000,000 of these pests have been exterminated, and the service performed in the interest of public health is enormous, when compared to the comparatively small outlay of money. The only pity of it is that the campaign had to be financed entirely by private means, and that the municipality of the District of Columbia could not "raise the ante" and make the prizes attractive to grown persons as well. It is not expected that in four weeks of the *Evening Star's* contest, Washington will be reduced to a state of absolute flylessness, but that there will be a slump in next season's crop there is not the slightest shadow of doubt. Considering the propagating possibilities of the fly, it would seem worth while for other cities to follow Washington's example in this regard and get the children started. Think of the enormous slaughter of flies there would be on the East Side, for instance, if the myriads of kids, excited by the prospect of winning a handful of dollars, could be induced to "swat the fly."

Restoring Hardened Rubber.—Everyone is familiar with the very undesirable change to which rubber is subject on prolonged standing, such articles as rubber tires becoming hardened and brittle. According to a note published in the *Motor World*, there is a simple remedy for this trouble, provided it has not gone too far. This consists in immersing the article for a short time in an alkaline solution composed of one part of ammonia to two of water. As an example of the efficiency of this process, an old bicycle tube which seemed beyond restoration was found quite fit for use after half an hour's immersion in such a solution. In explanation of the effect it is supposed that there is a tendency for acids to be formed in the rubber, and that these acids are neutralized by the alkaline solution. On the strength of this, it is suggested that when tubes or other rubber articles are stored, a small quantity of quick lime or ammonium carbonate be included in the wrapping, though it could be kept from actual contact with the rubber. Periodic washing with ammonia and water is also suggested as a preventive.

Boston Street Lighting.—The total number of lamps on Boston's streets on January 10th of this year comprised 3,973 arc lamps, 1,206 tungsten incandescent, and 11,742 gas. During the year 1910 the cost of electric lighting was $408,900; that of gas lighting, $277,256. Naphtha lights were used in small numbers during the year at a cost of $1,833, but all of these have now been replaced with gas lights.—*Municipal Journal.*



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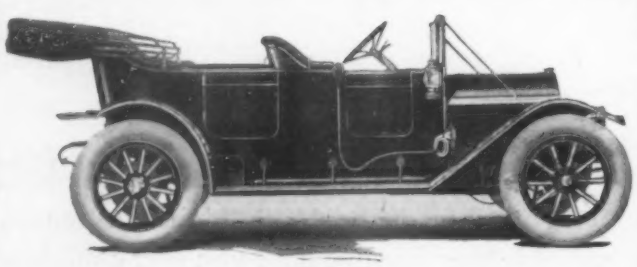

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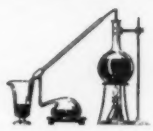

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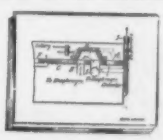

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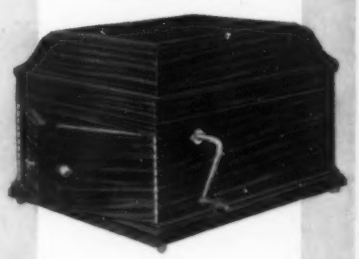

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